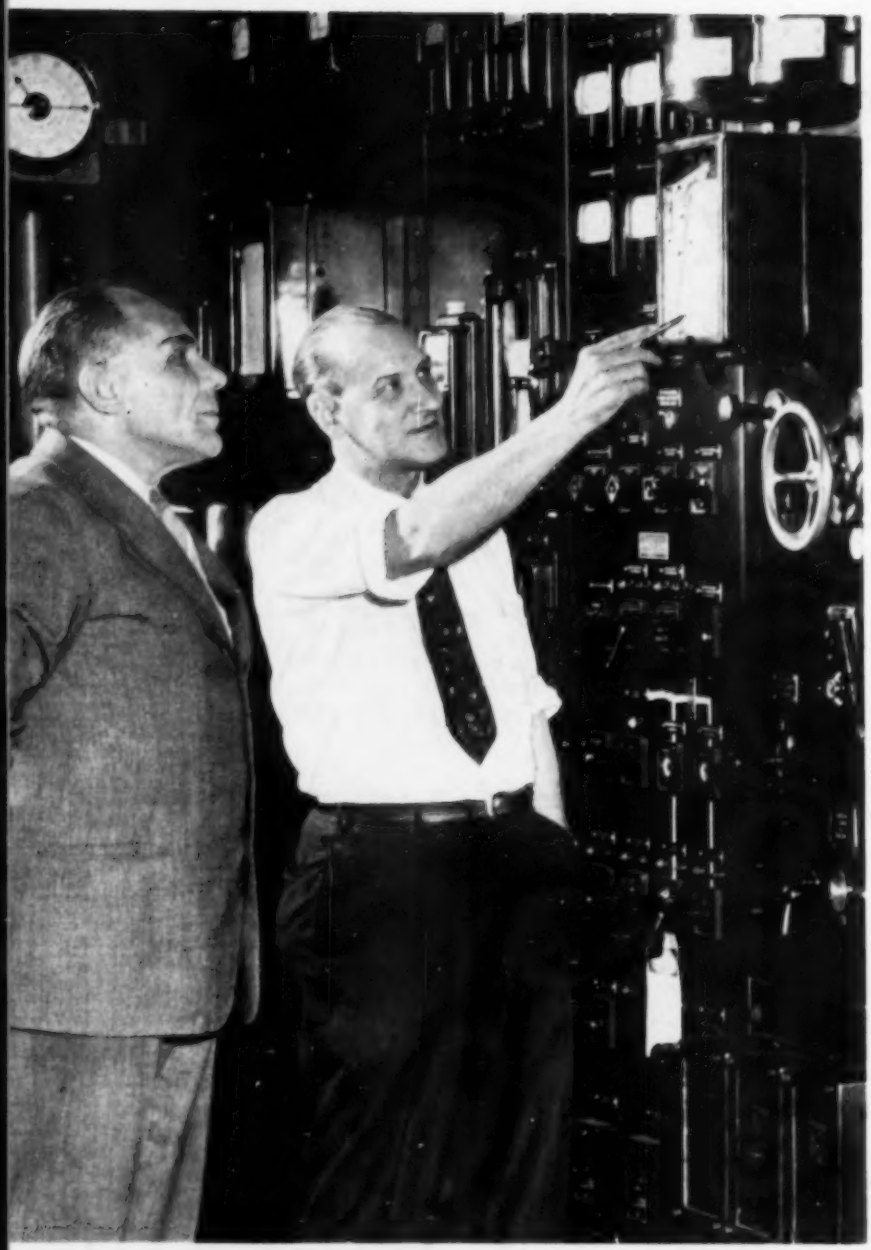
Industry and Power



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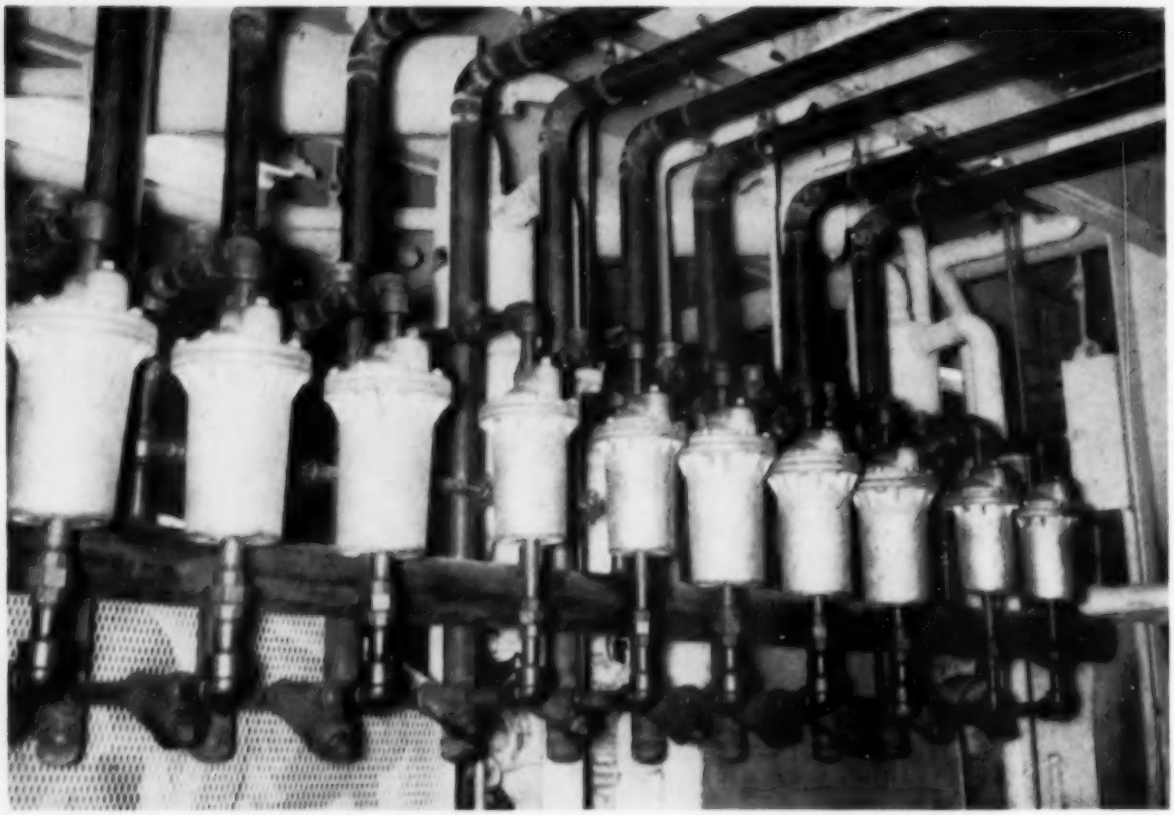


Tip on Choosing Steam Traps: Run Tests with a Pyrometer

Bottom inlet-top outlet traps in six sizes, ½" to 2" connections; 950 to 20,000 lbs/hr capacity.

Side inlet-side outlet traps in five sizes, ½" to 1¼" connections; 680 to 6700 lbs/hr capacity.

Integral strainer traps in three sizes, ½" and ¾". Cost less than trap and separate strainer, save fittings and labor.

A common problem—Traps on Rogers spray driers at Rochester Dairy Company, Rochester, Minn., required frequent servicing—used up about two months of one man's time annually. And, then, within about 30 days after trap servicing, drier temperatures would be 100 degrees below steam temperature. Nobody has to put up with such trap troubles!

Take a tip from this solution!—Henry T. Maass, Building and Utility Supt., took action. He ran extensive pyrometer tests on his driers, using different makes of traps.

100° hotter!—The driers are now equipped with Armstrong inverted bucket steam traps. Temperatures correspond to steam pressure—100 degrees hotter than before. Maintenance?—negligible. Rochester carries $63.31 of Armstrong trap parts in maintenance store against $873.52 in parts for another make of traps that haven't been replaced yet.

Moral—A small investment in Armstrong steam traps can make a world of difference in performance of production equipment and in cost of maintenance. Call your local Armstrong Representative, he has the products and the experience and the ability to be of real assistance.

FREE CATALOG

The 44-page Steam Trap Book is "the handbook of steam-trapping". Selection, installation, maintenance, capacities, data, prices, tables, charts, useful material—yours for the asking without any obligation. Also see data in Sweets or Chemical Engineering Catalog.

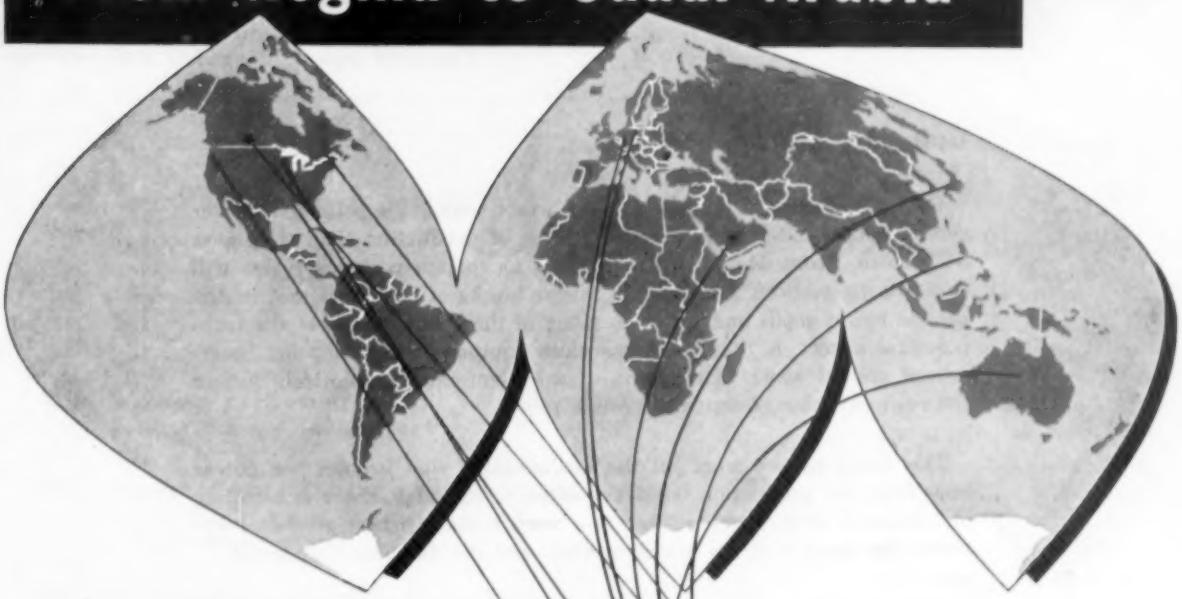
Armstrong Machine Works
820 Maple Street, Three Rivers, Michigan

Application Engineered

ARMSTRONG STEAM TRAPS

Circle 500 on reply card for more data

From Regina to Saudi Arabia



B-L VESSEL LININGS SET RECORD AFTER RECORD FOR DEPENDABLE PERFORMANCE

It looks like a Cook's Tour—but it isn't. Instead it's a listing of recent Bigelow-Liptak refinery installations in far-flung corners of the world.

There are good, solid reasons for this world-wide preference for Bigelow-Liptak jobs. In the first place from B-L's years of experience has come a *complete castable package*. Insulating- and abrasion-resistant castables are *engineered, furnished* and *installed* by the same company—which means just one contract and one responsibility.

The overall result of this all-in-one engineering is exceptional durability and performance. B-L refractory installations have established world records for continuous operation. For example, after initial runs of 785 and 610 days, B-L linings were in perfect shape—required no repairs during shutdowns.

A FEW OF OUR RECENT JOBS

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★ Regina, Canada	Regenerator and Cyclones
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• Yokohama, Japan	Regenerator and Cyclones
▲ Ras Tanura, Saudi Arabia	Regenerator—Reactor
• Copenhagen, Denmark	Kiln-Reactor
• Antwerp, Belgium	Kiln
• Norco, La.	Regenerator and Cyclones
• Altona, Australia	Reactors
• Mandan, North Dakota	Regenerator and Cyclones
and NOW!	
• Anacortes, Washington, U. S. A.	Regenerator, Reactor, Cyclones and Lines.

Yes, from Regina to Saudi Arabia—and points in between—Bigelow-Liptak installations are setting new records for service and performance. For complete information write for the B-L catalog "One Source". Do it today!

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4819

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this month's comment

. . . from industry & power

doff your bushelbasket . . . .

One of our authors, on page 47 to be exact, makes the point that power services contribute more to the unit cost of production than they ever did before. From where we sit, it looks as though power services will continue to grab off increasingly larger hunks of the costs met in the production of goods and services. (Part of the reason, aside of the technological aspect, is that power services equipment demands no "guaranteed annual wage." Utilization of such equipment is entirely within the realm of management's discretion.)

This being so, we must lift the bushelbasket that isolates the power boys from the production boys. Too often, even today, there is a feeling of insulation that disrupts what is a very natural interdependence between the domain of the power services and the domains they serve.

Power services can no longer be considered "overhead." (See "Into the crystal ball," p 86.) Power—whether it be delivered through pipes, over wires, via ducts, or by shafts and linkages—is today as much a raw material of production as is bar stock. Power consumption varies most directly in proportion to production activity. The "overhead" power services demand is becoming insignificant as compared to the variable demands of production.

One of the reasons, in fact, why we went after the story about the power services behind the Salk polio vaccine (I&P, June 1955, p 35) was that we were disturbed by the great amount of publicity given every aspect of that story—to the conspicuous exclusion of the power services. We felt that you, and everyone else concerned with Industry's Power Services, should be *aware* of how vital power services were to production of this vaccine—as vital, at least, as they are to industry in general.

It is this awareness of the vital, fundamental importance of the power services to industry that compels us to say, "get that bushelbasket off." Management hesitates but slightly in purchasing a production tool that will spit out piece parts more quickly, cheaply, and uniformly. But it hesitates considerably when sinking money into power equipment, simply because we have not sold management on the idea that power services are really raw material.

It behooves us then to get out of the boilerhouse and the substations. Management should be made aware, for example, that industry consumed 4.9 kwh per manhour of production in 1939—but that it is consuming about 10 kwh per manhour now, and will be consuming some 15 kwh per manhour by 1963 (I&P, August 1954, p 52.) Doff that bushelbasket so management can see just how much it has staked in power services.

Harold A. Bergen, Editor

The John Paul Taylor Publishing Co.
Commercial Bank Building, St. Joseph, Michigan

Industry and Power

Volume 69 **July 1955** Number 1

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nuclear news

. . . about industry & power

REACTOR PROGRAM ROLLS ALONG

New reports on the AEC's five-year reactor development program: The experimental boiling water reactor to be built by Allis-Chalmers at Argonne National Laboratory will have a leakproof power system to permit evaluation of the possibility of using heavy water rather than ordinary water in such boiling reactors. . . . Progress with the concepts of a liquid metal fueled reactor and an organic moderated and cooled reactor have reached the point at which it seems appropriate to plan additional experimental reactor projects. Such planning for exploitation of liquid metal fueled reactors is awaiting the results of an evaluation now being undertaken by Babcock & Wilcox. . . . Of particular importance to future industrial power plants is the AEC plan to begin more careful evaluations of the potential role of small and intermediate nuclear power plants, particularly power plants in the range from 25,000 to 150,000 kw. The AEC says "It is expected that much additional effort on design and evaluation of those smaller sized plants will be undertaken by groups outside the commission-sponsored program. . . ." Other concerns of the AEC are fuel research and technical manpower.

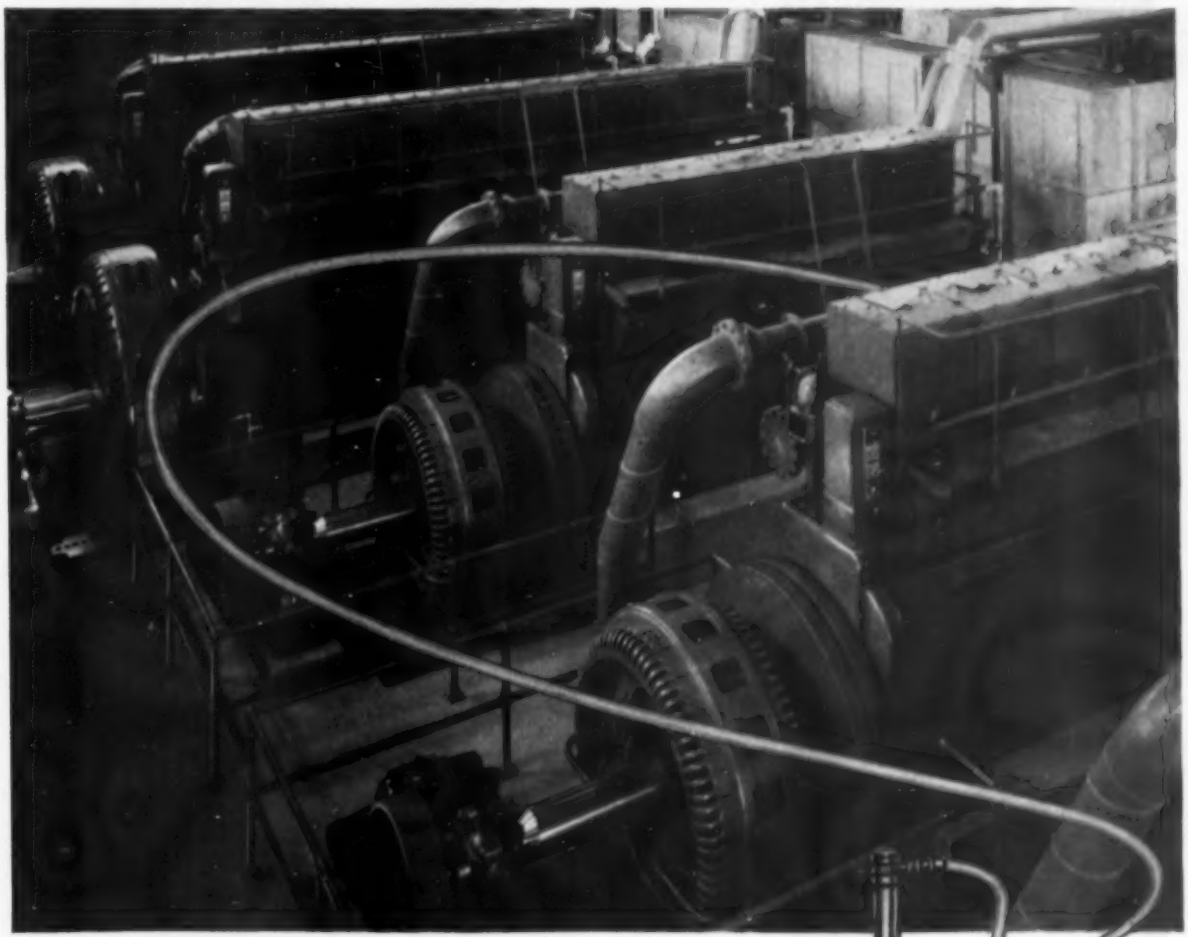
THE PROPULSION PICTURE

Two General Electric atomic experts have proposed an atomic reactor design that promises to remove many of the obstacles in the way of atomic power plants for use in airplanes, locomotives, and ships. The design they propose cuts in half the weight per horsepower of conventional atomic reactors and eliminates many moving parts that are standard in such equipment.

INFORMATION FOR THE ASKING

Under terms of the access agreements as reported in this column last month, 67 "access permits" have been issued by the AEC to organizations and individuals. . . . Nearly 300 papers in 50 sessions will be presented December 12 through 16 at the Nuclear Engineering and Science Congress in Cleveland. Representatives from 24 business and technical societies, 16 universities, 13 government bureaus, and 34 major industrial corporations will be repre-

Log More Hours!



Log more hours . . . the *extra* hours of peak performance you get when you switch to Sinclair RUBILENE®. RUBILENE guards diesels against sticking rings and prevents excessive wear of moving parts operating continuously for long periods. You will find that RUBILENE lubrication pays off in lowered maintenance costs and your engines log more time between overhauls.

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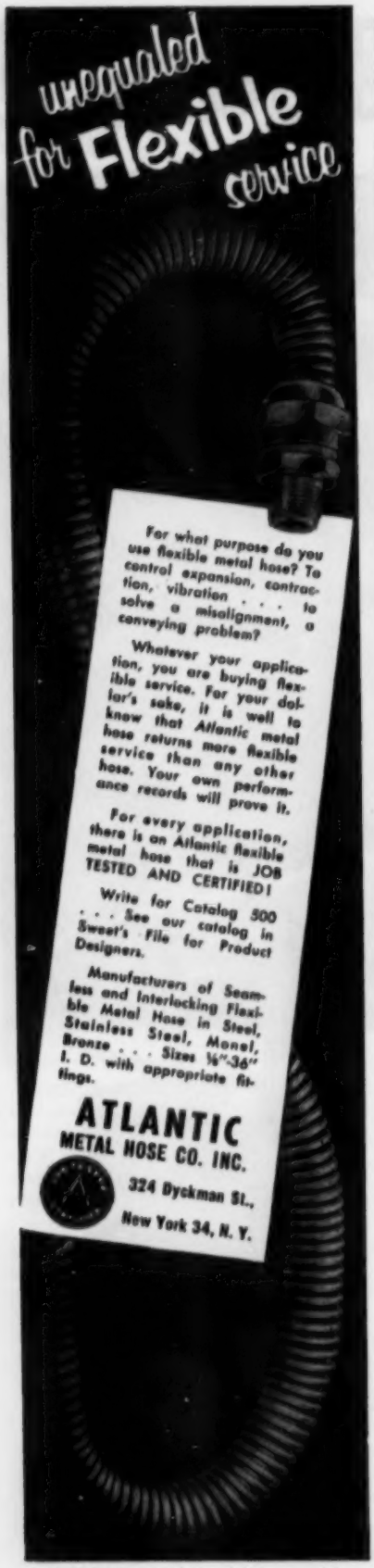
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ATLANTIC
METAL HOSE CO. INC.
324 Dyckman St.,
New York 34, N. Y.
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sented on a technical program covering practically every phase of peacetime uses. . . . New York University College of Engineering will inaugurate programs in nuclear engineering and engineering science this fall. NYU is among the first to offer the degree of master of nuclear engineering. . . . Rensselaer Polytechnic Institute has been designated by the AEC as an information depository for atomic data to serve northeastern New York and adjacent New England areas.

COMPLETE AGREEMENTS WITH OTHER COUNTRIES

The AEC has reached agreement with several countries under the "Atoms for Peace" plan proposed by President Eisenhower. An agreement with Switzerland has been concluded that covers sale and purchase of the research reactor that will be a central feature of the official United States exhibit at the forthcoming United Nations' International Conference on Peaceful Uses of Atomic Energy at Geneva next August. The agreement also covers exchange of information relating to the reactor, and the lease of special nuclear material to be used in the reactor. . . .

NUCLEAR POWER—HOW MUCH?

Estimates of future power needs in relation to nuclear energy continue to be offered. A nucleonics engineer at Minneapolis-Honeywell writes that in less than 50 years the world's demand for electrical power will exceed its supply of fuel unless atomic energy is harnessed as a source of energy. He says that there is on hand enough low-cost fissionable material to last four centuries—this being 400 times the amount of fossil fuel reserves (coal, oil, and gas) on which the world largely depends for power generation. . . . Westinghouse atomic scientists, on the other hand, report that there is 23 times more energy in the earth's nuclear fuel reserve than in all its conventional fuels combined—assuming one pound of processed uranium contains the energy value of 1,300 tons of coal or 230,000 gallons of fuel oil. . . . By 1975, estimates an official of Sylvania Electric, the production of atomic fuels and related activities will exceed $500,000,000 a year, and by 1985 will be measured in the billions of dollars. . . . The Chemical Institute of Canada was told that nuclear-fueled power stations in Canada may be generating 10,000,000 kilowatts before 1985. . . . And an AEC official wraps it up by saying "On a long-term basis, there is no question that nuclear power will be the major source of energy in this country."

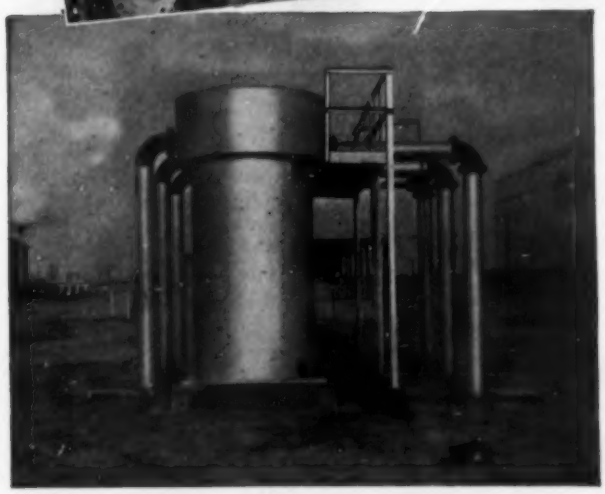
Dirty Water can't "Shut-down"...

Vogt

film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

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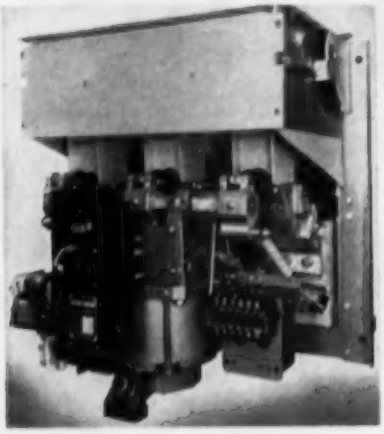
new equipment

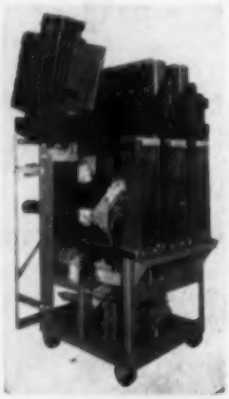
. . . for industry & power



G1—Switchgear uniform

Metal-enclosed switchgear is now available in a uniform three-high frame arrangement through 3,000 ampere air circuit breaker ratings for 600 volts and below. Units for 2,000- and 3,000-ampere service have compact design and can be fully isolated in steel compartments, 30 inches wide, 30 inches high, with minimum frame width of 58 inches. All switchgear test procedures can be completed with compartment doors fully closed, giving maximum protection for operators. A new handle-supporting assembly including escutcheon and visual indicator permit the doors to be shut with circuit breakers drawn out. This feature is standard for all I-T-E metal enclosed switchgear, 600 volts and below, through 3,000 amp circuit breakers ratings.

Normal maintenance of 7.2- and 13.8-kv metal-clad switchgear is now made easier because of a circuit breaker arrangement that permits each interrupter assembly to be tilted back by hand and safely anchored in inspection position. With the draw-out breaker wheeled out of its compartment, a removable arc-chute support is readily attached at the back and a lifting yoke at the front. Inspection position gives full view of interrupter plates within the chute and makes the entire contact assembly accessible for examination. I-T-E Circuit Breaker Company.

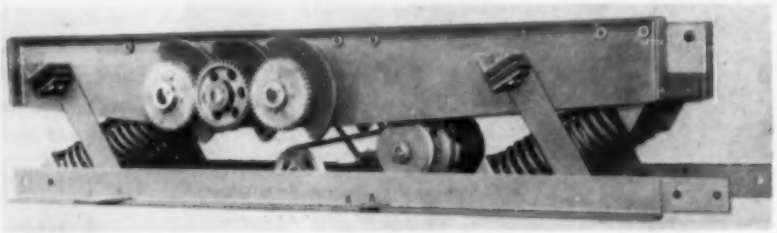


FREE INFORMATION

For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card facing page 77.

G2—Convenient checking

Combination thermocouple and temperature tester is designed for convenient checking of the milli-voltage output of thermocouples in both open and closed circuits. It is suited for testing either single or multiple thermocouple installations. It will also accurately check temperatures, within a range from room temperature up to 650 F, and will automatically compensate for changes in ambient temperature. Binding posts on the instrument are color-coded to prevent errors in connecting lead wires, and a special vinyl meter front and large meter pointer insure easier reading. The tester is simple to operate and comes complete with carrying case and all necessary instructions. Robertshaw-Fulton Company.



G3—Eccentrics give gentle flow to bulk materials

Oscillating conveyor designed with a minimum of moving parts meets a growing demand for vibrating conveyors to carry bulk materials. The Oscilveyor is a vibrating trough driven by rotating eccentric weights. It is made up of one drive unit and any number of standard trough units. Centrifugal forces alternately impact forward and backward thrusts to the trough and material flows like water along the trough. The action is gentle and the flow

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Many, if not most water or waste treatment problems are individual in character. They require study by *specialists* in order to reach a solution that is both operationally and economically sound. Such studies made by the staff of the Betz Consulting Division have saved much effort and productive time for hundreds of plants across industry. How can this important Division of Betz *completely-integrated* water conditioning service assist you?

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BETZ

CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

Circle 506 on reply card for more data

new equipment

. . . starts on page 10

of material is continuous and uniform throughout. Oscilveyor will feed uphill at inclines of up to 5 degrees. Troughs may be obtained anywhere from 8 in. to 24 in. wide, and in many metals. GIFFORD-WOOD COMPANY.

G4—Intercom system offers privacy and paging

Intercom system in attractive cabinets for desk, table, and wall mounting is designed to conserve valuable space. Central amplifier is the only unit that requires an electrical power outlet. Stations may be installed and full communication provided between

as many as six master stations in locations where no electrical power outlets are available. A privacy button is provided on every master unit to assure the user of absolute privacy, if desired. The system also provides complete facilities for paging. The system operates on 110/120 volts, 50-60 cps only. EXECUTONE, INCORPORATED.

G5—Console systems engineered for budget

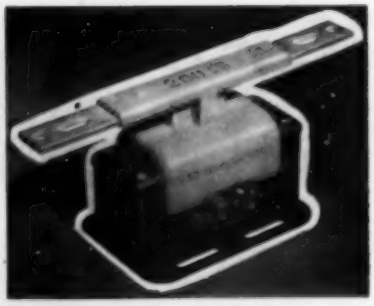
Sound system control consoles are individually engineered for the budget and coverage requirements of both large and small installations. One new console is a single-channel type (MI-14950) which permits two simultaneous sound operations and provides coverage for up to 40 rooms or areas. A second is a dual-channel type (MI-14951) which permits three simultaneous operations and coverage for up to 160 areas. Both consoles can be used for individual, group, or simultaneous coverage of all areas connected into the system. They permit communication between control desk and any remote area without interfering with programs being broadcast. Both consoles provide single-switch operation for broadcasting emergency signals to all outlets, and feature sloped control panels for easier reading. RADIO CORPORATION OF AMERICA.

TO REQUEST ADDITIONAL DATA

Circle key numbers on reply card facing page 77. Your requests will be handled promptly.

G6—Sealed silicone current transformer is lightweight

Silicone current transformer is designed for indoor metering and relaying applications. It is built in standard current ratings from 10 to 800 amperes. The transformer has a rating factor of 1.5 and is in the 0.3-per-



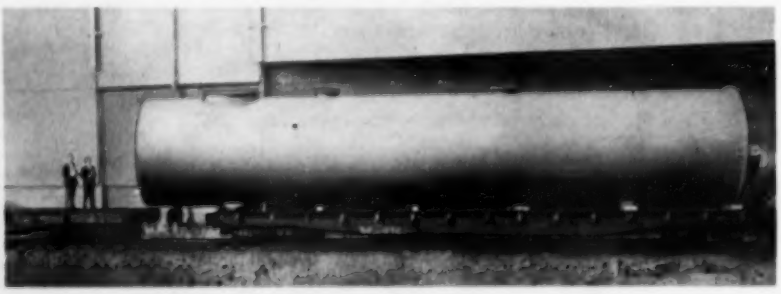
cent accuracy class for all metering burdens. It meets all ASA and NEMA standards. The new silicone-base insulating material is molded to the coil assembly, completely sealing it from moisture and air. It is unaffected by temperature change. The transformer weighs only 18 pounds and can be mounted in any position. A three-purpose secondary short-circuiting device can be operated automatically or manually. A transparent cover permits visual inspection of the low-voltage terminals and short circuiting device. WESTINGHOUSE ELECTRIC CORPORATION.

G7—Variable speed pulley for quick, easy installation

A variable speed pulley that provides speed changes of up to three to one ratio at from 7½ to 15 horsepower is now available. The pulley is easily and quickly installed on new or old equipment. Speed can be changed with finger-tip pressure while machinery is in motion. Standard bores are 1¼ inch, 1⅜ inch, 1⅝ inch. LOVEJOY FLEXIBLE COUPLING CO.

G8—Exhaust silencers eliminate high and low frequencies from vents, turbines, ejectors

Exhaust silencers have been designed to eliminate high- and low-frequency noises caused by gas-, steam-, and air-operated equipment. Acoustic reactance changers employ special sound absorbing material. They can be mounted on

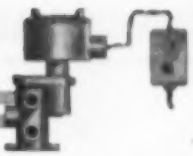


the exhaust of steam vents, gas turbines, hogging jets, evacuating ejectors, and so forth to smooth out the sharp, noise-producing impulses of discharging gases. A complete range of models is offered in standard 8- to 30-in. pipe sizes. Special sizes may be engineered to specifications. BURGESS-MANNING COMPANY.

(more new equipment on page 14)

For Remote Shut-off Applications...

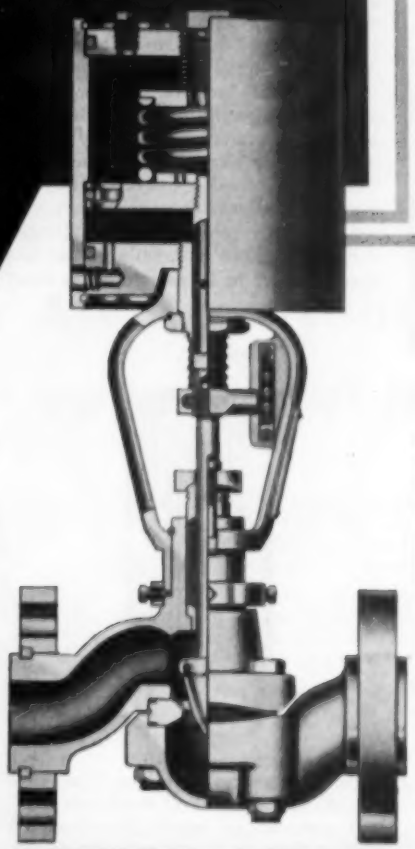
ANNIN CYLINDER VALVES



ELECTRO-PNEUMATIC SOLENOID PILOT ACTUATED

3-WAY OR 4-WAY MANUAL AIR ACTUATED

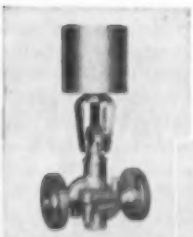
PNEUMATIC CONTROLLER ACTUATED



provide the complete answer!

...with these advantages:

- Positive shut-off
- Fast action
- Spring to open
  or
- Spring to close
- Globe, angle & 3-way bodies
- Carbon steel and all cast and forged alloys available
- Metal seats for high temperatures



MODEL 4520

MODEL 6520

and absolute shut-off dependability and safety with **ANNICO TEFSEAL SEATS** proven in dangerous services, such as Liquid Oxygen, Fuming Nitric Acid, Liquid Nitrogen and CO_2, Fuels and other FLUIDS at all pressures and temperatures −300° to +450° F

ANNIN *Control* VALVES

THE ANNIN COMPANY
6570 EAST TELEGRAPH ROAD, LOS ANGELES 22, CALIFORNIA

Circle 507 on reply card for more data

new equipment

. . . starts on page 10

G9—Welder on jeep moves to the job

Moving a self-sufficient welding unit from one job to another is no longer a problem with the jeep-powered mobile welder. The unit consists of a Lincoln 200- or 300-ampere generator with a large built-in exciter generator mounted on a Willys 4-

wheel drive jeep or truck. One or three kw at 115 volts is supplied by the exciter generator to illuminate the job or to run shop tools at the same time welding is being done. A belted power take-off system from the truck engine powers the welder and generator. Brackets for acetylene and oxygen tanks and storage boxes for tools and equipment are built into the unit. Front-mounted winch may be installed to raise, lower, or pull loads where other power is unavailable. A. J. Parsons.

FREE INFORMATION

For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card facing page 77.

G10—Improved heat transfer by direct condensate return

Greatly improved heat transfer in process equipment with substantial fuel savings result from direct discharge of condensate to the boiler with the C-B system of condensate control. System is based on a jet-loop design and uses a jet pump and a centrifugal pump. Completely closed system between equipment and boiler permits condensate to be returned to boiler at maximum temperature and pressure. Available in sizes to handle a wide range of volumes and differentials. Cochrane Corporation.

G11—Selective oil filtration combines versatility, convenience

Multi-cartridge oil filters permit selective filtration of oil. The new units combine versatility with operating convenience. They are recommended for a wide range of applications—engine lube and fuel oils, hydraulic oils, industrial cutting oils and coolants, air filter oils, and virtually any operation where oil can be bypassed. The flexibility of these units lies in the fact that six different types of cartridge refills may be used interchangeably. The filter is available in ten sizes, using 1 to 24 cartridges to meet

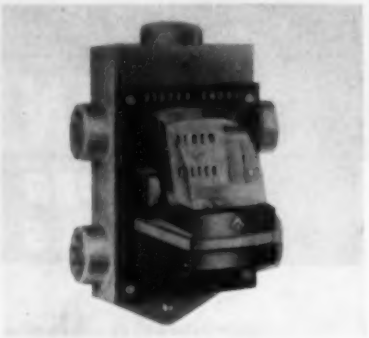
all capacity requirements. They are suitable for individual machines, central systems, or batch filtration. All models feature quick-opening covers for convenience in changing cartridges. A permanent neoprene gasket is used to seal the tank cover tightly. A spring-loaded pressure plate holds the filter cartridges firmly in position. Houdaille-Hershey, Inc.

G12—Single motor now labelled for many locations

Explosion-proof motors have received Underwriters' approval for use in all Class I, Group D, and Class II, Groups E, F, and G hazardous locations. All these new motors carry labels showing approval for use in all four of these hazardous locations. This reduces stocking problems because a single motor can be used for most hazardous locations. Available in ratings of 1 to 25 hp, 3-phase, and 2 to 3 hp, single-phase. Modifications of the new three-phase motors are also available with Underwriters' approval for use in Class I, Group C, hazardous locations. Louis Allis Co.

G13—Air filter gage continuously monitors ventilation

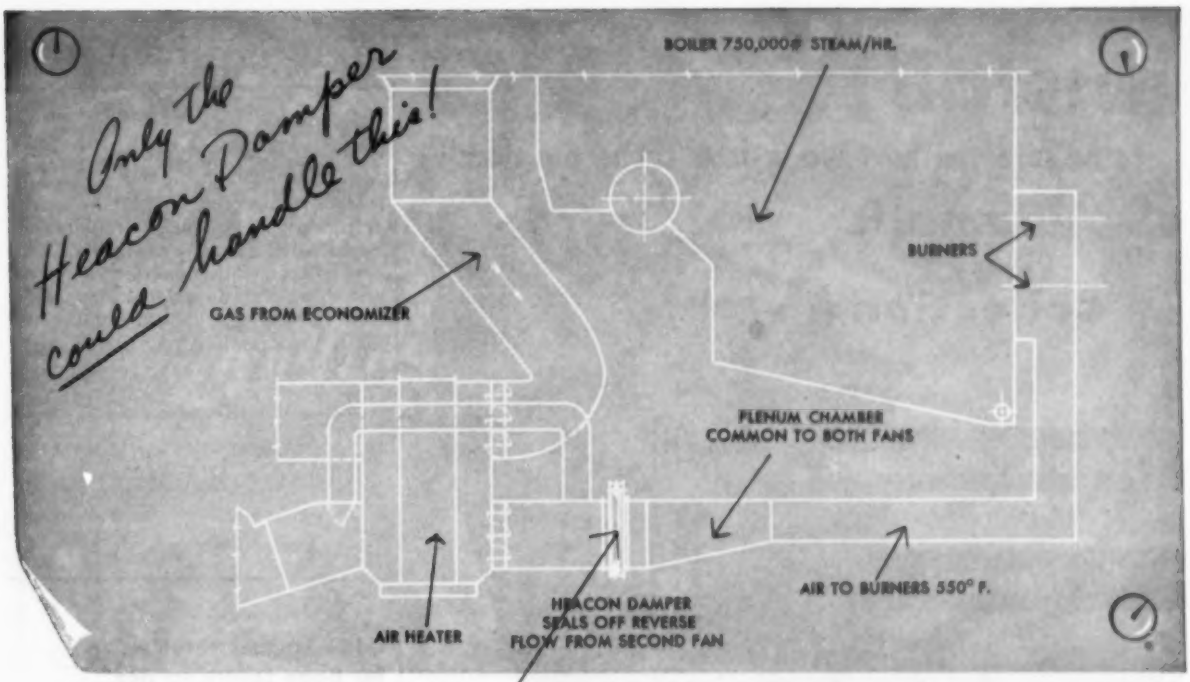
Air filter gage for industrial ventilating and air conditioning systems continuously and accurately monitors the dust removal efficiency of air filters.



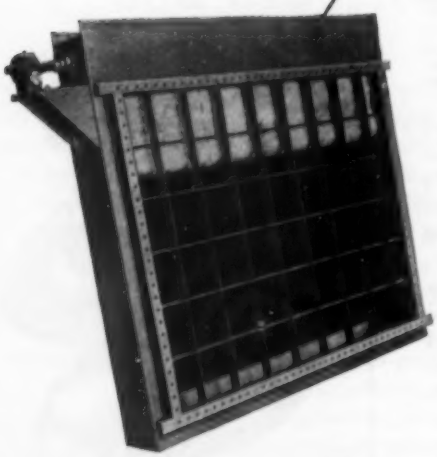
It operates on the principle of differential pressure measurement. When the pressure differential across the filter becomes excessive because of dirt accumulation, a signal vane behind the gage window flips into view, displaying the words "Renew Filter" on a bright orange background. Once the signal is actuated, it remains visible until the gage is reset after the filter has been cleaned or replaced. Units are available with pressure ranges up to 10 in. of water. A unique feature is a "built-in" calibrator, which makes possible setting the gage on the job if the manufacturer's specification of maximum allowable filter resistance is not available. The signal then is automatically actuated when the pressure across the filter has increased to twice the pressure differential of the clean filter. Bacharach Industrial Instrument Company.

G14—Packaged air conditioners take no floor space at all

Packaged air conditioners require no floor space at all. This new line is suspended from the ceiling or shelf-mounted, and includes both water-cooled and air-cooled (waterless) models. The waterless models are the first completely packaged air-cooled air conditioners in the industry. The units are available in 3-, 5-, and 7½-ton capacities and have hermetically


Only the Heacon Damper could handle this!
BOILER 750,000# STEAM/HR.
BURNERS
GAS FROM ECONOMIZER
PLENUM CHAMBER COMMON TO BOTH FANS
AIR TO BURNERS 550° F.
HEACON DAMPER SEALS OFF REVERSE FLOW FROM SECOND FAN
AIR HEATER

One of Two Air Pre-Heaters cleaned *while* Boiler operates at half load



THERMIX HEACON

There's a big difference in temperature between the inlet and outlet sides of this Heacon Damper installation when the damper is closed. There has to be because in this large western utility, air pre-heaters are cleaned while the boiler operates at half load!

This is made possible only because Heacon Dampers can effectively shut off high temperatures without leakage . . . can assure safety of personnel while boiler is in operation.

No other damper could assure the tight sealing so necessary in this installation. No other damper could provide these important benefits:

1. Quick return on investment through savings realized by operating steam generator at one-half load or better during cleaning operation.
2. Elimination of internal strains and possible damage during complete boiler shut-down.
3. Safety of personnel during cleaning operation.

Performance will prove to you as it has for others that Heacon Dampers are the most efficient dampers available anywhere. *Performance* in this installation resulted in 6 repeat orders for a total of 25 dampers!

Heacon Dampers are designed and constructed to meet practically any pressure or temperature specification. Our engineers will be glad to discuss your damper problems with you.

Project Engineers

THE THERMIX CORPORATION
GREENWICH, CONN.

(OFFICES IN 38 PRINCIPAL CITIES)

Canadian Affiliates: T. C. Chown, Ltd. 1440 St. Catherine St. W., Montreal 25, Quebec. 983 Bay St., Toronto 5, Ontario, Canada

Circle 508 on reply card for more data

Install Norblo

to be sure you have worry-free 'round the clock

Automatic Dust Collection

Automatic bag cleaning

No down time

Low, easy maintenance

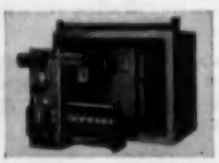
Norblo builds its own blowers in a wide range of capacities.

Norblo also builds centrifugal and hydraulic dust collectors, exhaust fans, cement air cooling systems, and portable type dust collectors.

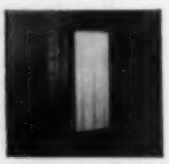
You can have continuous dust and fume collection at full rated capacity without a worry about maintenance down time. Norblo automatic bag type dust arresters handle heavy loads by faithfully maintaining a constant suction drop across the arrester. Compressed air shakers coupled with air reversal action assure efficient bag cleaning, one compartment at a time.

Norblo engineers the complete installation with ample capacity for your needs, with wide adjustability and all the safeguards you may need. Few moving parts combined with a fully coordinated functional design result in very high efficiency, low cost of operation and maintenance. It will pay you to have Norblo engineers study your requirements. Write for Bulletin 164-4.

Each group of 39 bags has its individual compressed air shaker.



The Norblo Variable Electronic Timer governs the shaking and cleaning cycle.



Any compartment may be cut out of the operation and inspected through access door.

The Northern Blower Company

Engineered Dust Collection Systems for All Industries

6422 Barberton Ave. OLympic 1-1300 Cleveland 2, Ohio

Circle 509 on reply card for more data

new equipment

. . . starts on page 10

sealed condensing units. The entire refrigeration system is replaceable. Accessories include a heating coil that can be used with steam or hot water and three-way directional air distributor for free air delivery within the area. GENERAL ELECTRIC COMPANY.

TO REQUEST ADDITIONAL DATA

Circle key numbers on reply card facing page 77. Your requests will be handled promptly.

G15—Manual reset valve for flame failure service

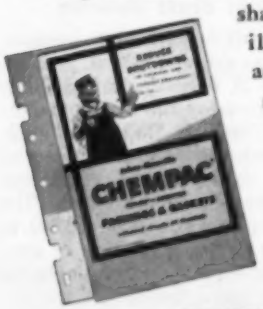
Series 81G Manual Reset Valves are especially designed for use with Fireye flame failure safeguard systems in shutting off the flow of fuels to oil and gas burners in cases of faulty operation. The valves have a positive, leakproof closing action and provide maximum protection against

burner explosion hazards. A foolproof manual reset mechanism prevents reopening unless the electric holding coil is energized. Full area port and straight-through body design give higher capacities with lower pressure drops. Glass insulated extra-power holding coils and corrosion-proofed latching assembly coupled with heavy duty construction assure trouble-free operation in most rugged industrial

Now—J-M Chempac-Interlocked Packing combines both "Teflon" and asbestos protection

Johns-Manville now introduces Chempac®-Interlocked Packing, with three important advantages for service in chemical and process equipment. Interlocked provides the excellent sealing and heat resistant qualities of asbestos. It is braided by the unique and exclusive J-M method, so that the asbestos yarns are securely interlocked and cannot come apart in service. And it is treated with chemically inert Teflon*, which is almost universally resistant to chemical and solvent action.

Chempac-Interlocked can be used to pack pump rods or shafts, rotary filters, mixers and similar apparatus handling strong acids, alkalis, caustic solutions and many other reagents at temperatures to 500F.



Other J-M Chempac Packings and Gaskets for the Chemical and process industries

J-M Chempac Packings in coil, spiral and ring form. Made of asbestos, treated with Teflon, they are available in types for caustic, acid, chlorine and solvent service.

J-M Chempac Gaskets with Asbestos-Teflon base. They have high mechanical strength and heat resistance, with excellent sealability at low bolt stresses.

J-M Chempac Folded Gaskets designed for glass lined equipment. Asbestos-Teflon base gives them high sealing effectiveness against a wide range of chemicals.

J-M Chempac Spirotallic Flange Gaskets for perfect sealing in high temperature and pressure service, constructed of interlocked plies of metal and Teflon-Asbestos.

*Trade Mark of DuPont Tetrafluoroethylene resin

Free Folder gives complete details on Chempac-Interlocked and other J-M Chempac Packings and Gaskets for the chemical and process industries. For your copy of folder PK-80A write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

JOHNS MANVILLE PRODUCTS

Johns-Manville PACKINGS & GASKETS

Circle 510 on reply card for more data

WHEN IT'S
Special BOLTS
and STUDS
Send your Specifications to
ERIE
40 years' experience in making special bolts, studs, nuts for specific job requirements.

Specialists in Precision High Quality
ALLOY STUDS

REPRESENTATION IN PRINCIPAL CITIES

Circle 511 on reply card for more data

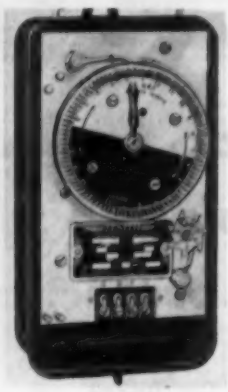
new equipment

. . . starts on page 10

service. Available in sizes from one to four inches for use with LP, manufactured, natural, or mixed gas and in 1-inch and 1¼-inch for use with preheated No. 5 or No. 6 oil. Combustion Control Division, ELECTRONICS CORPORATION OF AMERICA.

G16—Cycle power services with time switch

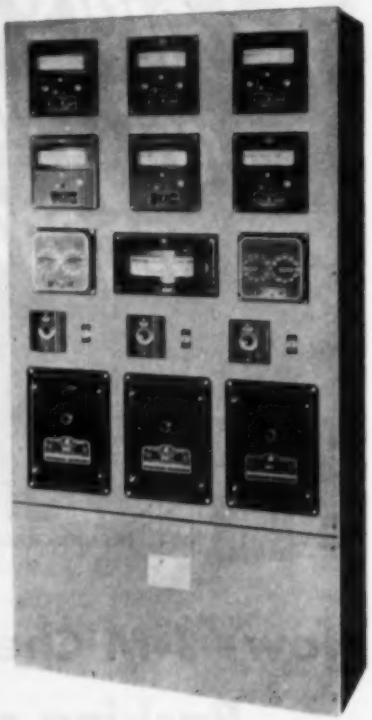
A 24-hour time switch just developed makes control of intermittent operations, including day or night shutdowns, completely automatic. It is especially adapted for marginal operation and accurate cycling of proc-



essing equipment, of heating, ventilating, and air conditioning systems, of stokers, of oil, and of gas burners. Switch dial is scaled in 15-minute graduations. It can be set for as many as 48 "on" and 48 "off" operations, automatically repeating on a 24-hour schedule. Switch is available with or without a calendar device to cut out non-working days. Rated capacity is 1000 watts. Operates at 60 cps, a-c, 110/240 volts. Single-pole, double-throw switch. ZENITH ELECTRIC CO.

G17—Two systems available for flame control safeguards

Two flame control systems, one based on a flame rectification principle and the other using a lead sulphide photo-conductive cell that is responsive to infra-red, are now available. All models of both series are housed in a smartly designed cabinet and incorporate a plug-in type chassis. Designed to give maximum accessibility for adjustment, examination and repair, new prewired control centers have been designed and engineered to provide a simple, efficient method for conveniently hous-



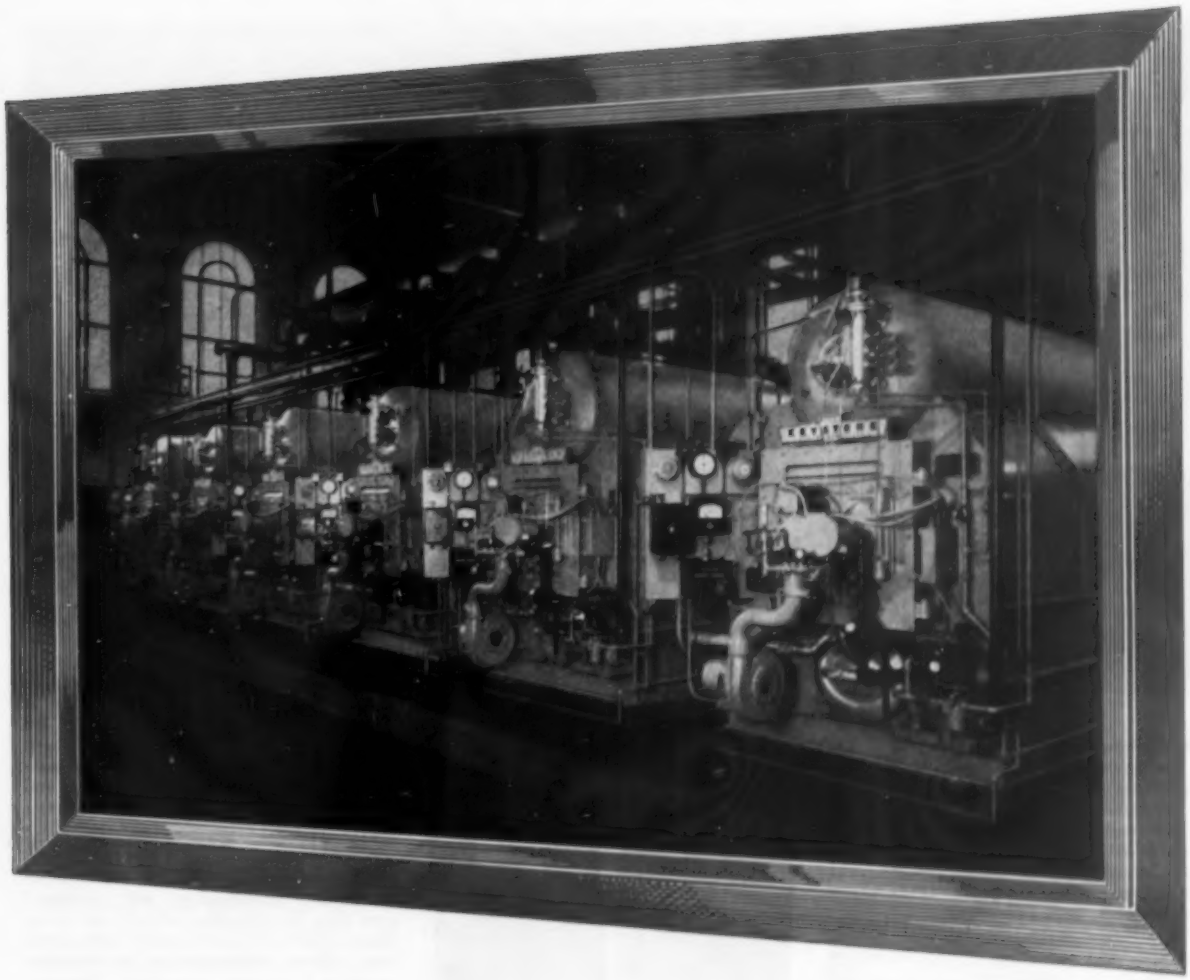
ing combustion safeguards, pilot lights, alarms and all other components and instruments of a complete combustion safeguard system. Wheelco Instruments Division, BARBER-COLEMAN COMPANY.

FREE INFORMATION

For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card facing page 77.

G18—Gas-fired unit heaters have built-in draft diverter

Gas-fired unit heaters with horizontal discharge are of modern, streamline design. A built-in draft diverter makes unnecessary the usual unsightly devices on the flue connection. Burners are heavy-wall cast iron with accurately drilled ports. Automatic safety controls are provided. The heaters range in size from 50,000 to 230,000 Btu/hr input. A line of gas-fired unit heaters is also available for ceiling suspension and downward discharge through fixed or revolving discharge outlets. These unit heaters are approved by the AGA. L. J. WING MANUFACTURING CO.



There's Steam Economy in FLEXIBILITY

Above, six Erie City Keystones meet a variable heating and processing steam load at the Ohio Masonic Home in Springfield, Ohio

JOSEPH BRESLOVE & ASSOCIATES
Consulting Engineers
Cleveland, Ohio

Picture the boiler operating advantages of multiple Erie City Keystone Steam Generators in your plant. Multiple "Keystones" permit high efficiency operation. During periods of low loads, take one or more units off the line—for high loads, the rapid steaming "Keystones" respond quickly to increased requirements.
Compact, completely factory assembled and Factory Fire Tested "Keystones" fit into any plant's variable steam needs.
There is nothing to assemble in the field.
Need steam at some remote plant location indoors or outdoors? Investigate the use of one or more "Keystones." Bulletin SB-51 describes the fully automatically controlled Keystone.

ERIE CITY
115 Years in Steam Generation

You can depend on Erie City for sound engineering

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

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new bulletins

. . . for industry and power

200-Dry-type transformer types
The applications, sizes, types, and construction of air-cooled dry-type transformers is described in Bulletin 155. Specifications are included. Special custom-built transformers and reactors are discussed. Eight pages. SORGEL ELECTRIC COMPANY.

201-Packaged medium boilers
The principal features of design and performance of controlled circulation hot water boilers are presented with sketches and engineering specifications in Bulletin P-391. Also included is a section on controls and an oil pump, heater, and strainer unit. Sixteen pages. COMBUSTION ENGINEERING, INC.

202-Fine dust collection
Typical applications of centrifugal air washers are shown in Bulletin W-555. Information of specific interest to those responsible for fine dust collection is included in the operation description. Four pages. THE DUCON COMPANY.

203-D-c contactors and relays
Heavy-duty d-c contactors and control relays for heavy industry applications are described in Bulletin 14B8171A. Available in ratings from 25 to 100 amp. 600 volts maximum, the units feature many interchangeable parts. Illustrated with a color code chart. Eight pages. ALLIS-CHALMERS MANUFACTURING COMPANY.

204-How to simplify piping
Swivel joints provide an ideal solution for piping connections to moving or moveable machine parts. Catalog 265-B contains complete specifications, dimensions, and application data. Twelve pages. BARCO MANUFACTURING CO.

205-Simplify drafting practices
Sample drawings of engineered parts and assemblies illustrate the eleven rules (from the use of word descriptions for simple parts to making free-hand drawings wherever possible) for simplifying drafting practices. These simplified methods have shown that it is possible to cut the total number of hours required to complete a given volume of work by 40 to 50 percent. Thirty-six pages. AMERICAN MACHINE AND FOUNDRY COMPANY.

206-Do's and don'ts for bearings
A helpful list of "do's" and "don'ts" to prolong bearing life appears in Bulletin 506. Also included is information on the storage and handling of lubricants. Four pages. NEW YORK AND NEW JERSEY LUBRICANT CO.

207-Automatic sump pump data
Complete engineering data on a line of sump pumps that covers every application is presented in Bulletin 5530. Submersible sump pumps, vertical pumps, and hydraulic operated drainers are discussed. Four pages. PENBERTHY INJECTOR COMPANY.

208-Controlled volume pumps
Use of controlled volume pumps in typical industrial water treating processes such as coagulation systems, lime soda softening, hot process softeners, demineralization and other boiler water treatment systems is fully described in Bulletin 953. Also includes a thorough analysis of cooling tower water treating problems as well as methods and systems for waste and sanitary water treatment. Twenty-four pages. MILTON ROY COMPANY.

209-Rugged trolley conveyors
Rugged yet simply designed ball bearing trolleys that are engineered to assure rolling contact with the track at all times are described in Bulletin 2536. The steel wheels have treads that are machined and hardened for maximum life. Also included are specification and application data and a list of commonly used attachments. Twenty pages. LINK-BELT COMPANY.

210-Felt as a design material
This design book discusses felt and its properties, its special treatment, and its use throughout industry. Included are sections on how to select felt, recommended uses, specifications and how to order felt. Application information includes its anti-fraction, cushioning, filtering, insulating, sealing, and wicking properties. Twenty-two pages. THE FELTERS COMPANY.

TO REQUEST ADDITIONAL DATA

Circle key numbers on reply card facing page 77. Your requests will be handled promptly.

211-Save with slatted pulleys
How welded steel slatted pulleys extend conveyor and elevator belt life is explained in Leaflet 898. Not only are belts saved, but the pulley itself lasts longer than conventional solid-face pulleys. A chart gives sizes, dimensions and weights. Two pages. THE JEFFREY MANUFACTURING CO.

212-Vibration engineering specs
Complete specifications and performance data for vibration, shock, and noise control products are available in Bulletin K4A. Eleven different types of vibration isolating units are presented. Detailed discussion of the relative merits of springs and organic materials as isolating media is given. Includes an easy-to-read selector chart. Four pages. KORFUND CO.

213-Sintered bronze filters
Basic information on the advantages of porous bronze as a filtering medium and complete engineering data on bronze filters already in use on industrial applications are offered in this new bulletin. The company's free creative engineering service is also discussed. Sixteen pages. PERMANENT FILTER CORPORATION.

214-Indoor and outdoor boilers
Design data on indoor and outdoor installations of modern high-pressure,

COOL HEADS IN "HOT SPOTS" WON'T LET YOU DOWN

On jobs where the air is foul or hot, men can't be blamed too much for letting up now and then. If you want to keep their efficiency and morale high, feed them better air.

Employers have learned the value of putting Coppus Blowers and Ventilators on the job . . . in confined areas and near furnaces or hot processes. The men work faster, do better work, work longer without fatigue — and appreciate the more comfortable working conditions.

Give some thought now to the "hot spots" in your plant. There is a Coppus Blower for practically any requirement — Cable Manhole and Tank Ventilators, Boiler Manhole Blowers and Exhausters, Heat Killers, Shiphold Ventilators, etc. The Coppus "Blue Ribbon" is your assurance of design and construction planned for plenty of severe service. Check and mail the coupon for specific information. Coppus Engineering Corp., Worcester 2, Mass. Sales Offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG.

ANOTHER
COPPUS
"BLUE RIBBON" PRODUCT

COPPUS ENGINEERING CORP., 187 PARK AVENUE, WORCESTER 2, MASS.
Please send me information on the Blowers that clear the air for action.

- ☐ in tanks, tank cars, drums, etc.
- ☐ in underground cable manholes.
- ☐ in aeroplane fuselages, wings, etc.
- ☐ on coke ovens.
- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.

COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausters, welding fumes.
- ☐ stirring up stagnant air wherever men are working or material is drying.

NAME .....
COMPANY .....
ADDRESS .....
CITY .....

(Write here any special ventilating problem you may have.)

Circle 513 on reply card for more data

new bulletins

. . . starts on page 20

high-capacity steam generating units are presented in Bulletin S-55. Also includes charts and tables on the Springfield line of boilers and includes information on superheaters, economizers, air-heaters, steam temperature controls, and steam purifiers. Twelve pages. SPRINGFIELD BOILER CO.

215-Modern tube expanders

The latest tube expanding equipment available for fire-tube boilers, water-tube boilers, condensers, and similar heat transfer units is described in a bulletin that discusses recommended applications. THE GUSTAV WIEDEKE COMPANY.

216-Data for full line of valves

Complete lines of valves for industrial use that meet a wide range of pressure, temperature and corrosion conditions are offered in Catalog No. 654. Specifications and engineering data are included. Sixty-six pages. REPUBLIC MANUFACTURING CO.

217-Burn refuse simply

Simple and effective method of firing refuse and cellulose fuels in a spreader stoker fired unit is discussed in Bulletin 5M-455. This pneumatic refuse fuel distributor has no moving parts and spreads a thin fuel bed for quick response to load changes. Eight pages. RILEY STOKER CORPORATION.

218-Travelling crane conductors

Typical assemblies for various types of conductors and components of the assemblies are illustrated in Bulletin 7100. Design data for the location of current conductors are included. Eight pages. PHILADELPHIA TRAMRAIL COMPANY.

219-Longitudinal finned tubing

These finned tubes permit the use of heat exchangers that are smaller in size, weight, and space than units with bare tubes. Bulletin 1300 tabulates more than a dozen ferrous and non-ferrous material combinations and the many sizes of fins and tubes that are available. Also mentioned is the interrupted type of fin tube for use with viscous fluids. Four pages. THE GRISCOM-RUSSELL CO.

220-Electronic flow meters

Choice of several mercury-less transmitters is offered with these electronic flow meters, described in Bulletin 55-1074-222. They are suitable for measurement of differential pressures, of liquid level, of fluid, gas, air or steam flow, of temperatures, and of pressures. Combination of flows or flow and level can be recorded on the same chart. THE HAYS CORPORATION.

221-Complete motor buying data

Complete buying information on standard a-c fractional and integral horsepower motors is presented in Bulletin GEC-1026. A special section on selection of integral horsepower motors covers lead requirements, enclosures, starting current limitations, speeds, motor types, and selection of fuses and circuit breakers. Information on all motors includes descriptions, specifications, and standard modifications. Twenty-eight pages. GENERAL ELECTRIC COMPANY.

222-Corrosion resistant conduit

Test data show how specially protected heavy-duty rigid-steel electrical conduit stands up under corrosive attacks of salt spray, acid, alkali, and in other environments that have extreme moisture and heat conditions. A special baked-on coat of pigmented and plasticized vinyl chloride acetate copolymer, gives exceptionally high corrosion-resistance. NATIONAL ELECTRIC PRODUCTS CORPORATION.

FREE COPIES

For free copies of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card facing page 77.

223-Light-load steam trap

A ½-inch impulse steam trap especially designed with low capacity to handle light condensate loads is now available. The trap will not freeze or air bind on steam tracer line service. It is good for all pressures to 400 psi. Bulletin T-1740-20A gives a complete description. YARNALL-WARING COMPANY.

224-How to choose circuit breakers

All essential information on the selection and application of molded case and large air circuit breakers is presented in this Speedfax catalog. Application sections make extensive use of charts and tables to explain selection of circuit breakers for motor circuits, bus duct, conductors, and transformer secondary applications. Also included are the latest prices, dimensions, and ordering instructions—arranged and indexed to reduce reference time and eliminate errors. Sixty pages. I-T-E CIRCUIT BREAKER COMPANY.

225-Dry transformers for high temp

Designed for higher temperatures to keep weights and dimensions as low as possible, these new totally-enclosed dry-type transformers with NEMA group three, class H insulation for indoor, outdoor applications are described in Bulletin 61B8222. A discussion of the advantages with high-temperature insulation is included with questions and answers on dry-type transformers. Four pages. ALLIS-CHALMERS MANUFACTURING COMPANY.

226-Standby portable generators

Flat-compounded electric plants that maintain a constant voltage from no-load to full-load are described. Units range from 275 watts to 5,000 watts, dc and 850 watts to 12,500 watts, ac. A-c units also provide 100 to 200 watts dc for battery charging. Units feature pushbutton starting. Four pages. MULTI-MATIC CORPORATION.

227-Make best use of controls

To realize greatest benefits from automatic control, your knowledge of products and processes must be supplemented by an intimate knowledge of control engineering. Bulletin S-10 describes how to arrive at the right application of an automatic control system. Several case histories are cited. Fourteen pages. AUTOMATIC TEMPERATURE CONTROL CO.

228-Stokers are more flexible

Stokers for bituminous coal and anthracite are explained in detail with many illustrations in Bulletin 553. Complete specifications and ratings are included. Photographs and drawings of side ash dumps are also given. Twelve pages. CANTON STOKER CORPORATION.

229-Complete control valve index

Complete engineering data on industrial automatic controls are tabulated with prices in Catalog 1-55, which also includes an index by name and by number. Forty-six pages. GENERAL CONTROLS.

230-Solenoid valve flow control

If you use direct operated solenoid valves for automatic or remote flow control of liquids and steam to 400 F, or of high viscosity liquids, you will want to read Bulletin V-3. Normally closed, normally open, explosion-proof normally closed, three-way valves and accessories are shown. Twelve pages. THE JOHNSON CORPORATION.

231-Automatic liquid proportioner

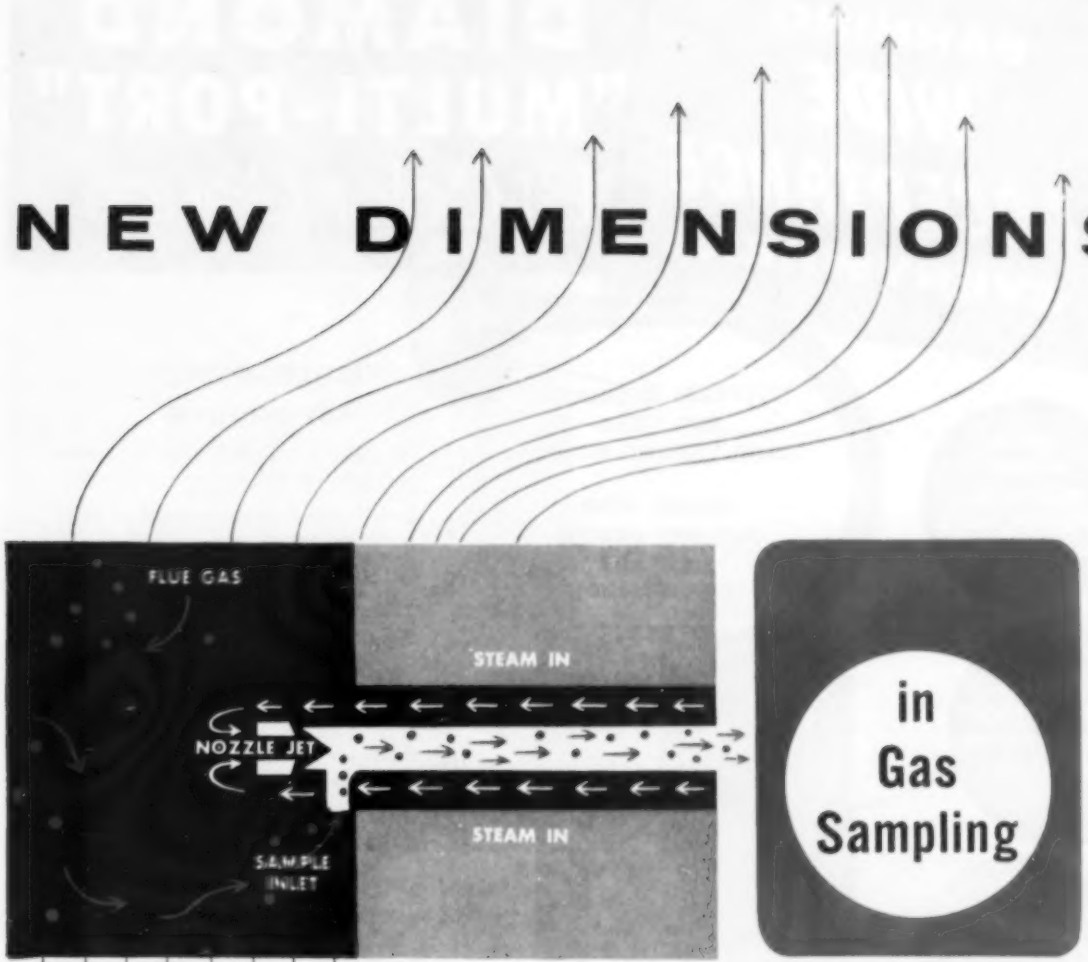
The measure mix is an automatic device for injecting liquids into water in very accurate proportions, without the use of outside power connections. Proportioners permanently set to any proportion in the range of 1 in 25 to 1 in 500 are described in Bulletin R-8. SMITH PRECISION PRODUCTS COMPANY.

232-Handy pocket charts

Charts for wire gauge and temperature conversion are available in a pocket-size Bulletin No. GEZ-1510. The bulletin is printed on durable plastic material in large easy-to-read type. GENERAL ELECTRIC COMPANY.

(more bulletins on page 68)

NEW DIMENSIONS



NEW SAMPLING SYSTEM OPERATES ON STEAM!

The new Hays Gaspirator* System is designed especially for difficult gas sampling problems involving high dust loading and high temperatures. It now permits accurate O_2 measurement, previously impossible in many applications.

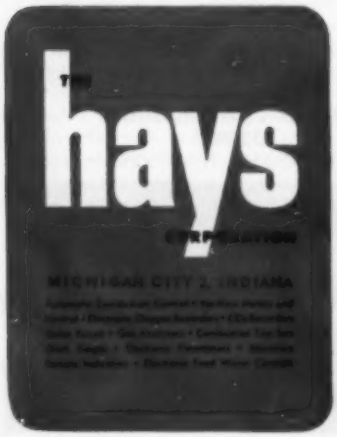
This gas sampling system uses steam to obtain a continuous, clean sample. Suction which is created by the jet nozzle draws the sample in, where it is mixed with the steam. The steam is then condensed. Condensate and entrained solids drop down, and the sample is forced through the analyzer under pressure.

Hays, in the field of gas analysis for more than fifty years, developed the Gaspirator for use with their Magno-Therm Analyzer.

This analyzer, which operates on the paramagnetic principle, has for years been accepted as the leader in the field of O_2 measurement. Hundreds of companies are using the Magno-Therm and Hays electronic recorders very successfully in boiler plants and on process furnaces as a combustion guide, in regeneration of catalysts in refineries and in many other process applications.

For further details write for Bulletin 55-829-56.

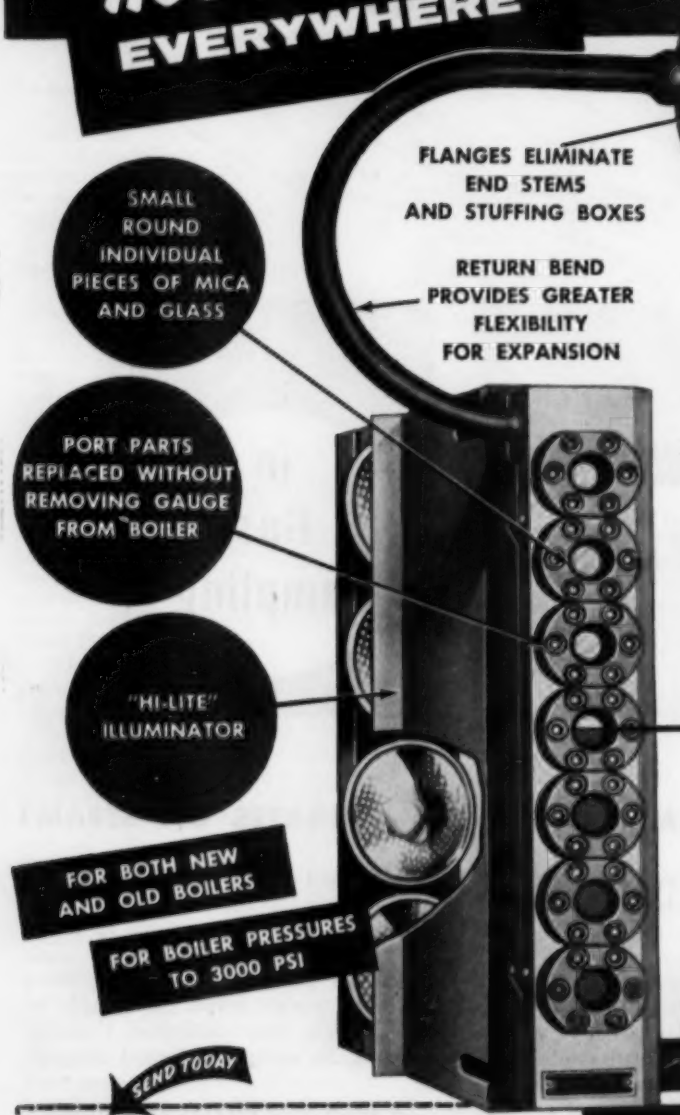
*Patents pending.



Circle 514 on reply card for more data

EARNING
WIDE
ACCEPTANCE
EVERYWHERE

DIAMOND "MULTI-PORT" Bi-Color Gauge


SMALL ROUND INDIVIDUAL PIECES OF MICA AND GLASS
PORT PARTS REPLACED WITHOUT REMOVING GAUGE FROM BOILER
"HI-LITE" ILLUMINATOR
FOR BOTH NEW AND OLD BOILERS
FOR BOILER PRESSURES TO 3000 PSI
FLANGES ELIMINATE END STEMS AND STUFFING BOXES
RETURN BEND PROVIDES GREATER FLEXIBILITY FOR EXPANSION
STEAM SHOWS RED
WATER SHOWS GREEN
WELDED CONSTRUCTION ASSURES PERMANENT TIGHTNESS

"MULTI-PORT" Advantages:

(1) "Bi-Color" principle shows steam red and water green

(2) Small round ports instead of long glass strips

(3) "Hi-Lite" Illuminator for improved visibility

(4) Simplified high-pressure construction

(5) Maximum thermal stability for rapid starting

(6) Easy, inexpensive maintenance . . . in place

(7) Direct reading . . . basic reference gauge

The "Multi-Port" gauge has been in continuous successful high pressure operation for more than two years in leading central station plants. Users everywhere report excellent readability and substantial savings in gauge maintenance costs. For additional information, write for Bulletin 1174.

7211

SEND TODAY

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO

Please send me without obligation a copy of new Bulletin No. 1174 explaining the advantages of the Diamond "MULTI-PORT" Bi-Color Gauge.

X

NAME_____

COMPANY_____

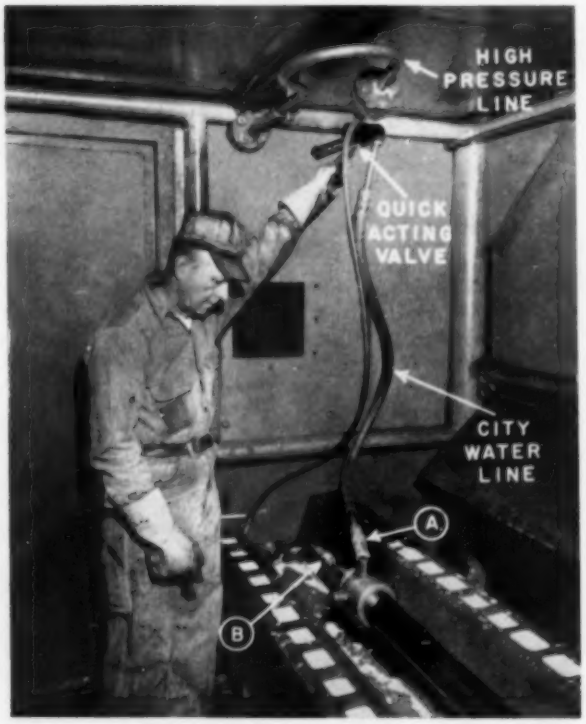
ADDRESS_____

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO
Diamond Specialty Limited—Windsor, Ontario

Circle 515 on reply card for more data

ideas in action

. . . for industry & power



Quick-connect coupling for h-p testing

By ingenious use of a special quick-connect hose coupling, the Pittsburgh Steel Company has developed a simple, low-cost supplement to its regular high-pressure testing facilities for steel pipe. A recent modification of American Petroleum Institute specifications required test pressures as high as 10,000 pounds per square inch. An operator, inside the test compartment, turns a quick-acting valve in a city water supply line for rapid filling of the test pipe through double-check valve coupling A. After bleeding air, overflow is plugged. Pipe under test is connected to a small water supply from a high-pressure pump through coupling B.

Full pressure (9,700 pounds) is kept on for 0.1 minute. A Quick-Seal coupling supplied by Titeflex, Incorporated has met all requirements for high-pressure operation. The total cost of this ingenious setup was very low compared with the cost of standard machines built for the job. Furthermore, this setup was constructed in a few weeks. Twelve-month delivery time would have been necessary for standard, commercial machines.

Tax savings and lagging

The use of machinery mountings can possibly reduce your taxes according to results of a survey undertaken by Barry Controls, Incorporated. Although tax laws differ throughout the country, it has been established that in many areas a machine that is not lagged to the floor is taxed as personal property. It is, therefore, subject to accelerated depreciation provisions. On the other hand, machines that are bolted or lagged to the floor are considered in many parts of the country as part of the realty and are subject to taxes applied to that realty. When leveling mounts are used, the book value of equipment is lowered by taking advantage of the accelerated depreciation provisions. Since book value is usually accepted as the basis for assessment purposes, the reduction in this value reduces the amount to be paid in property taxes. Possible benefits vary throughout the country. Local tax commissioners should be contacted to obtain specific rulings applying to any area.

Special hose cuts costs

A large southern paper mill has eliminated one cause of costly shutdowns by the use of specially designed hose. In the manufacture of kraft paper, efficient operation demands a high recovery of the sodium salts used in pulp digestion. After pulp washing, a weak black liquor is obtained containing about 20 percent solids. Ingenious furnaces have been designed to burn the solids in the black liquor. Sodium sulfate is thereby changed to sulfide, and heat is generated for steam production. The black liquor is evaporated to 60 percent solids, heated, and pumped through a six-foot length of hose to a nozzle. One furnace

may have several nozzles. The nozzle oscillates in a vertical plane to spray the liquor efficiently. The liquor is introduced into the furnace at 17 psi and 240 F, which is above its boiling point. The water therefore evaporates immediately, the solid particles expand and fall to the hearth and are burned as fuel. The ash containing the sodium salts is recovered, purified, and recirculated to the digesters for process.

These hoses must resist chemical attack, abrasion from the high solid content, heat, and pressure. In addition, they must withstand constant flexing as the nozzles move up and down about six times per minute. Specially designed hose has increased hose life by 100 percent. The inventory of spares and manhours required for cutting and installing hose have been reduced.

Hose consumption has also been reduced in the steam-

ideas in action

. . . starts on page 25

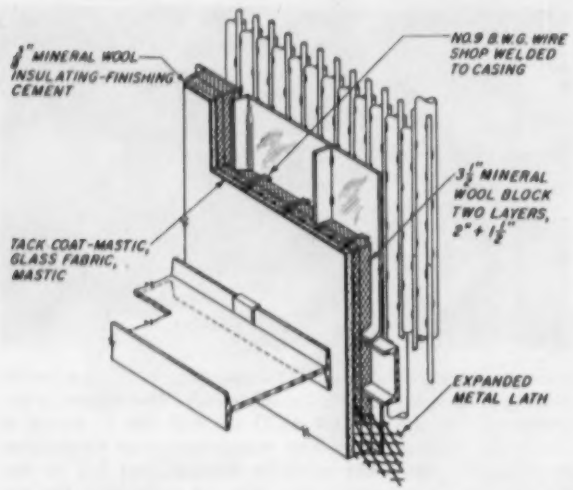
lancing operation. When the black liquor is burned, some of the solids are deposited on the tubes of the boiler in a cake or crust, which reduces heat transfer. A steel lance is inserted in access holes provided near the top of the boiler. Steam injected through the lance breaks down the cake which falls to the furnace bottom to be recovered with the ash for reprocessing. The steam pressure used is 140 psi.

Here again, the hose must withstand high pressure and temperature as well as the abrasive action in being constantly dragged over the floor. Flexing is also severe as the lancer constantly inserts and withdraws the lance.

Boiler settings are now inside-out

The construction of pressurized furnaces, becoming increasingly common for economical power production, presents many unusual design problems. For example, the thermal insulation on the boiler water walls is placed outside the steel boiler casing, rather than between the casing and tubes, as in a conventional system. The insulation is no longer protected from weather and abuse by the casing, nor is it held securely in place on both sides.

Riley Stoker Corporation specifies spun mineral wool block as the basic insulation for covering pressurized furnaces. Two layers of blocks are attached to the boiler casing by soft annealed iron wire that has previously been shop welded to the casing. Expanded metal lath, secured

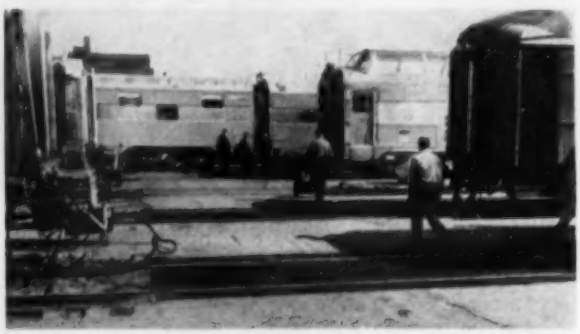

3/8" MINERAL WOOL INSULATING-FINISHING CEMENT
NO.9 B.W.G. WIRE SHOP WELDED TO CASING
3½" MINERAL WOOL BLOCK TWO LAYERS, 2" + 1½"
TACK COAT-MASTIC, GLASS FABRIC, MASTIC
EXPANDED METAL LATH

by the same tie wires, is fastened to the outside of the block to provide a base and reinforcement for a ⅜-inch thick coat of mineral wool insulating-finishing cement. This cement, finish troweled, provides a satisfactory finish for indoor installations. For outdoor installations, a tack coat of asphaltic mastic, a layer of glass fabric and a final coat of mastic are specified.

The use of insulating-finishing cement plays a major part in the success of this "inside-out" construction. These modern dual-purpose cements do not shrink upon drying, and therefore do not require pointing up of shrinkage cracks. They dry in a fraction of the time required by conventional insulating cements (which eliminates bubbling of asphalt finish if applied over wet insulating cement), and do not wash off if exposed to rain before being weatherproofed.

Crossing requires no maintenance

Until 1953, the crossing of two tracks in the Corwith Coach Yards of the Santa Fe railroad in Chicago consisted of creosote-treated timbers about 2½ to 3 inches thick. They were held together with lag screws. Constant maintenance was required to keep the crossings safe and smooth enough for trucks. Then Blaw-Knox grating was installed, each section protecting an area about 8 feet wide and 16 feet long. Since installation, there has been no maintenance required on the grating, although three 4,000-pound lift trucks carrying up to 4,000 pounds of brake shoes drive over the crossings some 50 times a day along

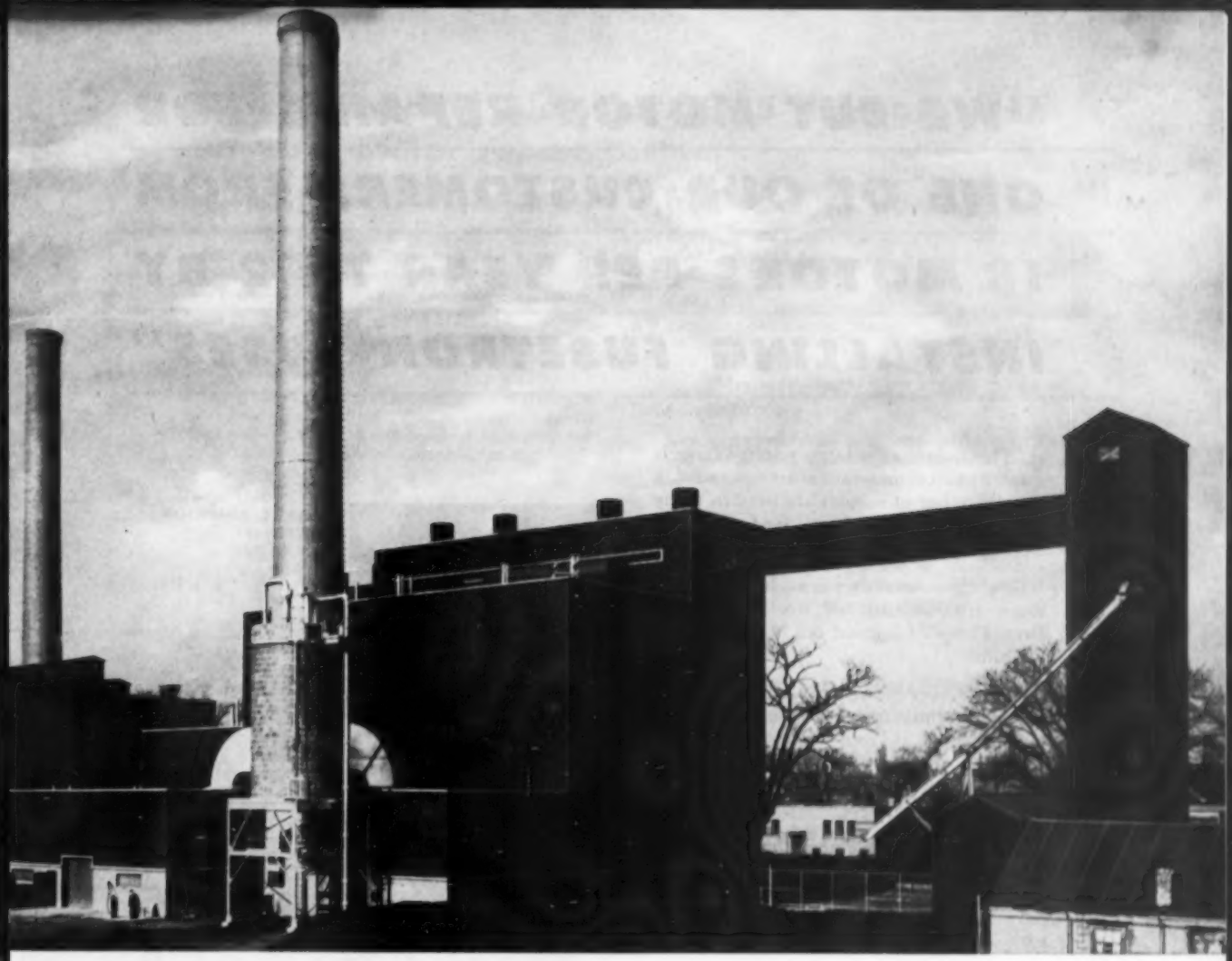


with other heavy service trucks. Beside being easy to maintain, it has improved housekeeping, is more attractive, and provides better working conditions than the original wood crossings.

Light oil recovery process is effective

A specially designed system for recovery of light oil from coke oven gas, recently installed at the Midland (Pa.) Works of Crucible Steel Company of America, has increased recovery more than ten percent using only one of two existing absorption towers. The conventional process for absorption of light oil basically consists of circulating a petroleum fraction of very low volatility through an absorption tower counter-current to the coke oven gas. The light oil is then stripped from the wash oil in a stripper tower. Using only one of the existing towers and converting it to a spray type absorber, Rust Engineering Company designed and engineered a simple, efficient scrubbing system uniquely suited to this process. Required intensity of contact is obtained in the new system by circulating the oil at a high velocity with pumps.

(more ideas in action on page 90)



Syracuse U. burns coal the modern way for dependable steam supply

Over the past decade, there has been a growing demand on the steam plant at Syracuse University. Not only has the university itself expanded rapidly, but six hospitals on or adjacent to the campus depend on university facilities for steam. When the original steam plant proved inadequate (total output 190,000 lbs. per hr.), the university built a completely up-to-date unit to replace it.

The internal operation of this new plant is as modern as its panel and glass exterior. An automatic handling system delivers the coal from hopper to bunker to pulverizer to boiler. A pneumatic-type integral combustion control system operates the boilers automatically. A pneumatic disposal system removes fly ash and cinder ash automatically. Today Syracuse University is assured an adequate steam supply—capacity 300,000 lbs. per hr.—and a clean, economical operation in the process.

Investigate Your Fuel Costs

If you're planning to modernize your plant or build a new one—or if you are just interested in cutting fuel costs—find out how coal, burned the modern way, compares to other fuels. Why not talk to a consulting engineer or your nearest coal distributor? Their advice may save you thousands of dollars each year.

facts you should know about coal

Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar.

Automatic coal and ash handling systems can result in a virtually labor-free plant.

Coal is the safest fuel to store and use. No dust or smoke problems when coal is burned with modern equipment.

In most industrial areas, bituminous coal is the lowest-cost fuel available.

Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

NATIONAL COAL ASSOCIATION
Southern Building, Washington 5, D.C.

Circle 516 on reply card for more data

"WE CUT MOTOR REPAIRS FOR ONE OF OUR CUSTOMERS FROM 18 MOTORS PER YEAR TO 2 BY INSTALLING FUSETRON FUSES"

"The owner of a large poultry farm is one of our customers. In his operation a great number of motors are used in many different ways — pumps, feed grinders, heating systems, ventilators, etc.

"But these motors were giving him so much trouble that we were rewinding from 12 to 24 burned out motors a year for him.

"To correct the trouble, we suggested protecting the motors with Fusetron dual-element fuses. He told us to go ahead and try them. So, after checking the circuits and motors, Fusetron fuses were installed in proper sizes.

"Fusetron dual-element fuses proved themselves from the beginning. For the entire year following their application, only 2 motors were repaired and this trouble was caused by over lubrication.

"The motors we rewind are guaranteed for a year so we want to be sure they are properly protected. That's why we recommend to all our customers that they use Fusetron dual-element fuses."

Lawson E. Cobb
President
NEW ENGLAND ELECTRIC MOTOR EXCHANGE INC.
GARDNER, MASS.

ROBERT E. HENRIKSON
Shop Foreman

FUSETRON is a trademark of Bussmann Mfg. Co.

Harlan F. Cobb
Vice President

FUSETRON dual-element FUSES do more than cut your motor repair costs

Fusetron fuses save you recalibration and maintenance costs

Fusetron fuses are *calibrated at the factory by engineers.* Once properly installed, they require no periodic inspection or down-time necessary on mechanically operated devices.

Fusetron fuses eliminate down-periods caused by needless blows

Fusetron fuses can increase production and reduce annoying interruptions of regular maintenance because — they wipe out needless blows caused by harmless overloads or excessive heating.

Fusetron fuses increase life of equipment

If there is an electrical fault, Fusetron fuses open and warn of danger and help hold fault to its source.

Panels and switches are protected against damage due to poor contact heating.

100,000 amp., interrupting rating gives you maximum safety

Fusetron fuses can safely interrupt the most severe available short circuit current — and are adequately safe to meet future circuit growth.

Fusetron fuses save on installation costs

They protect against waste of space and money by permitting use of proper size panels and switches, instead of oversize.

Here's why Fusetron fuses give all-purpose protection

A fuse link combined with a thermal cutout — the result, a fuse with tremendous time-lag and much less electrical resistance and an interrupting rating in excess of 100,000 amps.

They have the same degree of Underwriters' Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to same dimensions as ordinary fuses. FUSETRON Fuses fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.

Write for bulletin FIS.

For loads above 600 and up to 5,000 amps., Use BUSS Hi-Cap Fuses . . .

They have unlimited interrupting capacity to handle any fault current regardless of system growth.

They can be coordinated with Fusetron fuses on feeder and branch circuits to limit fault outages to circuit of origin.

Write for bulletin HCS.

BUSSMANN MFG. CO. Div. of McGraw Electric Co.
University at Jefferson, St. Louis 7, Mo.

Play Safe! **install FUSETRON dual-element Fuses and BUSS Hi-Cap Fuses throughout entire Electrical System!**

FUSETRON
BUSS

FIS

Circle 517 on reply card for more data

our readers write

. . . to industry & power

Brooklyn readers: Help!

Gentlemen:

In the September, 1954 issue of INDUSTRY & POWER there was a very interesting item concerning chemical grouting method on pages 79 through 81. I would be very interested in finding someone in our area in Brooklyn with whom I could discuss the use of this method.

I have inquired locally and can find no one who could give me the name of any contractor or service organization handling this method. I have, however, found places where this method has been used successfully. The use to which I would like to put this is for the prevention of settlement in addition to seepage.

Anthony S. D'Amato
Factory Supt.
Manifold Supplies Company

● *We will be happy to forward all suggestions to Mr. D'Amato.*

Painting again

● *The following is in reply to the recent letter of Mr. Frank R. Pitt (I&P, June, 1955, p 32.)*

Gentlemen:

Thank you for the letter of April 15, 1955 regarding my article on specifying paint protection. I appreciate your interest. We too are always seeking information and better ways of making sound applications of protective coating materials. I personally have no objection to spray application or any other manner of application if it is properly done and results in a coating that will give maximum performance.

Applications made in industrial plants, shipyards, and in the field are much more difficult to keep free of dust, dirt, and other contaminations. I find that men working with brushes notice the surface they are painting more than when spraying. Perhaps they are not the best spray painters, but there are a lot of them working and industry is trying to get maximum performance from their work.

Of course, it is my contention that the only way industry can be sure of getting a good application is to control the job with experienced supervision and inspection on the job at all times. The applicators also appreciate such control because it relieves them of future arguments as to whether or not the specifications were followed. Also, the inspector's report is a record which may explain the cause of possible failure of the protective coating.

As a matter of fact, when I am following an application job, either brush application or spray application of wash primer and the prime coat is permitted unless otherwise restricted in the specifications. It is usually a matter of which method is most convenient. But I make certain the surface is clean and that the application is proper.

Air will blow away free dust, but I often observe fine clay material even on sandblasted surfaces which cannot be blown but comes off readily when wiped. Perhaps such particles are held by small charges of static electricity. At any rate, such fine dirt will spoil the bond to the steel or between coats of paint, especially vinyl materials. Also, dirt often is blown into corners at the joints between steel, and is then bridged over with paint when sprayed.

It is my personal feeling that more paint film is needed to protect automobiles and I have also seen some pretty poor paint jobs come out on new cars. An assemblyline affair is one where very close application control is impossible. As for corrosion prevention by painting of ships, I think a lot of improvement is needed and can be made. I don't mean in terms of brush application vs. spray application, but by proper surface preparation and protective coating engineering to give maximum corrosion protection.

To date, I do not have any actual exposure tests where brushed or sprayed paints gave longer or better performance if both were properly applied. As a general rule, I find that the paint film of oil paints, such as referred to in the article, result in a greater thickness when brushed. But I will grant that brush marks are not preferred. The marks showing on the pictures are brush marks and are the result of using heavy, hard-to-brush paint in order to get increased film buildup per coat. The failures, however, are due to lack of protective film and to millscale flip-up causing the paint film to break and allow more moisture to get at the steel.

Considerable quantities of vinyl materials were applied, by the hot-spray application, on offshore drilling structures last summer (1954). The oil companies have gone back to cold-spray applied vinyls this year. Personally, I think the idea is fine, but applicators try to lay down too great a film thickness too fast. More investigation and research plus selling and training the workmen in the use of the equipment are needed to make such applications practical.

It was nice hearing from you and may our interests and problems bring us together in the near future.

Warren D. Palmer
Protective Coating Engineering
And Inspection Service
Houston, Texas

Old refreshers available

Dear Sir:

After reading the June issue of INDUSTRY & POWER, I became very interested in Professor John Lee's article entitled "A Thermodynamic Refresher." I would appreciate it very much if you can send me the first copy of this series which I missed.

Paul Pytal
Engineering Department
Paul O. Abbé Inc.
Little Falls, New Jersey

● *Requests for copies will be filled as long as supplies of each article remain available.*

Future thermo refreshers

Gentlemen:

There are four of the fellows in the Plant Engineering Department that are interested in studying and keeping notes on the refresher articles of thermodynamics which began a series in the May, 1955 issue of INDUSTRY & POWER. We would greatly appreciate receiving four reprints of each article published on this subject.

W. F. Weitzel
Plant Engineer
Western Electric Company
Greensboro, N. C.

Gentlemen:

We read with interest your article "A Thermodynamics Refresher", chapter one. We would very much appreciate it if we could have the complete series of this refresher course for our files, when it is completed in the magazine. Several of our men have expressed an interest in "catching up" on this subject.

Freeman Felt
Electrical Engineer
Rayonier, Inc.
Shelton, Washington

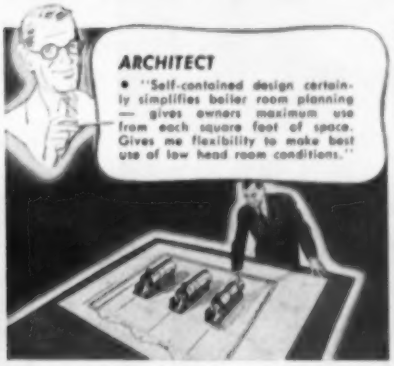
● *All requests for future articles in the "Thermodynamic Refresher" series are being carried forward. As each article is published, the standing requests will be filled.*

CLEAVER-BROOKS SELF-CONTAINED BOILERS HAVE THE FEATURES EVERYONE WANTS!

...which feature would be most important to you?

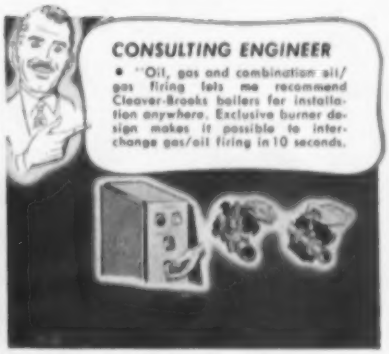
PLANT OWNER

• "Cleaver-Brooks boilers are tops in fuel economy! Forced-draft, four-pass construction and 5 sq. ft. of heating surface per boiler H.P. assure me 80% operating efficiency when firing with oil."



ARCHITECT

• "Self-contained design certainly simplifies boiler room planning — gives owners maximum use from each square foot of space. Gives me flexibility to make best use of low head room conditions."



CONSULTING ENGINEER

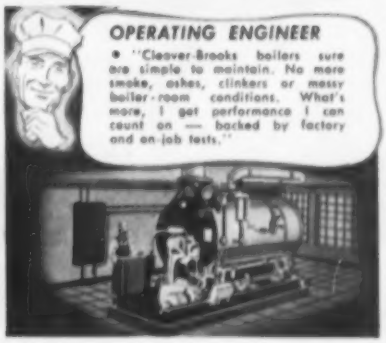
• "Oil, gas and combination oil/gas firing lets me recommend Cleaver-Brooks boilers for installation anywhere. Exclusive burner design makes it possible to interchange gas/oil firing in 10 seconds.

CONTRACTOR

• "Boilers are shipped ready to install. With service lines in, my crews have boilers ready for operation in 24 hours or less after delivery. No foundation or stack problems. Cleaver-Brooks furnishes starting service, too."

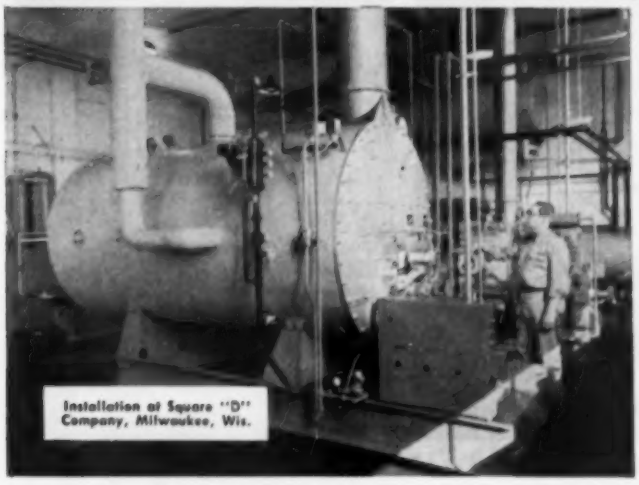
PLANT SUPERINTENDENT

• "I get all the steam I need for fluctuating steam demands, from full load down to 30% of rating. Automatic burner controls assure instant firing. I call that *real* dependability."



OPERATING ENGINEER

• "Cleaver-Brooks boilers sure are simple to maintain. No more smoke, ashes, clinkers or messy boiler-room conditions. What's more, I get performance I can count on — backed by factory and on-job tests."



Installation at Square "D" Company, Milwaukee, Wis.

THESE are just a few of the many outstanding features that have made more than 15,000 individual Cleaver-Brooks self-contained boilers *first choice* for commercial, institutional and industrial applications. Get in touch with your nearest Cleaver-Brooks representative for complete facts, or write for catalog AD-100. Cleaver-Brooks Co., Dept. H-303 E. Keefe Ave., Milwaukee 12, Wis., U.S.A. — *Cable address: CLEBRO — Milwaukee — all codes.*

Cleaver Brooks

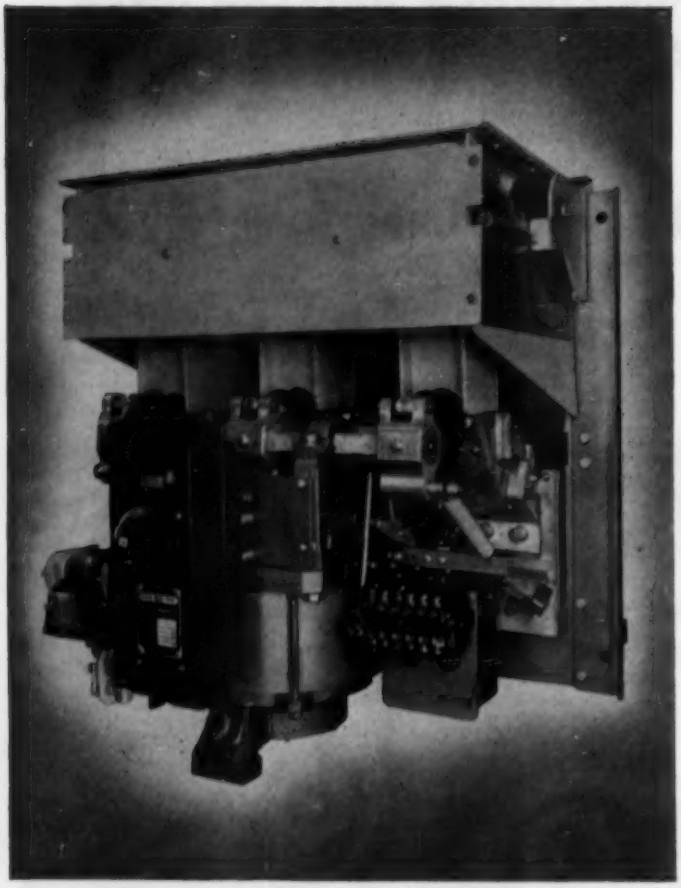
"It's NEW — get the facts on the CB boiler — write today!"

BOILERS — STEAM OR HOT WATER — FOR HEATING OR PROCESSING IN SIZES FROM 15 TO 500 HP, 15 TO 250 PSI.

NOW — FIRST SIZES OF THE CB BOILER ARE MADE IN CANADA, TOO.

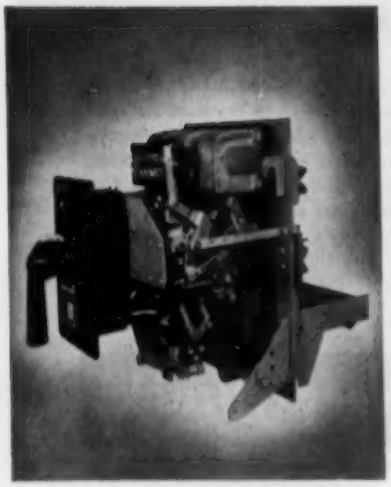
Circle 518 on reply card for more data

News of new developments in

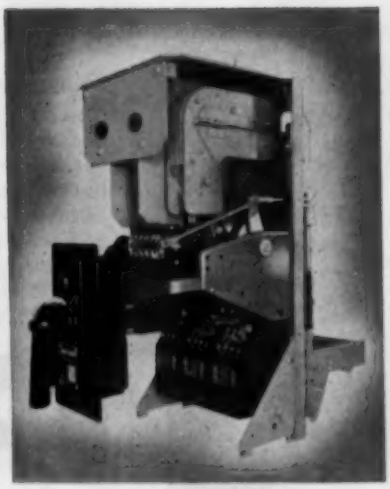


K line of circuit breakers now made through 3000 amp continuous, 75,000 amp interrupting at 600 v a-c

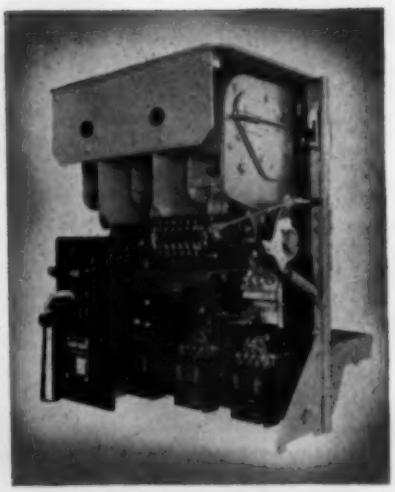
The new Type KD Air Circuit Breaker extends I-T-E's established three-high line of K breakers. It is an extremely compact metal panel breaker which incorporates the proved performance and generous safety factor of the KA, KB and KC breakers. As an integral part of I-T-E switchboard design, it offers the additional advantage of accessibility in minimum space.



KA Circuit Breaker



KB Circuit Breaker

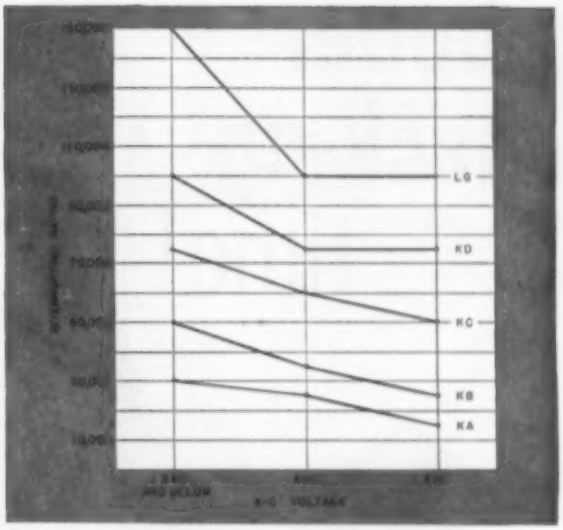


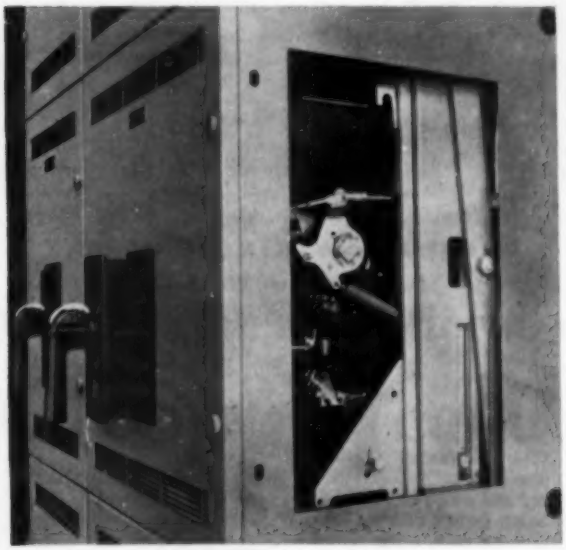
KC Circuit Breaker

I-T-E Low Voltage Switchgear

Circuit breaker interrupting ratings increased in keeping with proposed industry standards ▶

You save, because these standards reduce switchgear costs by permitting the use of lower interrupting rating breakers for short circuit protection in 240 v a-c and 480 v a-c systems. And with smaller breakers you save space, too. Uprating of I-T-E Types KA, KB, KC, KD and LG Air Circuit Breakers is shown in the accompanying chart.





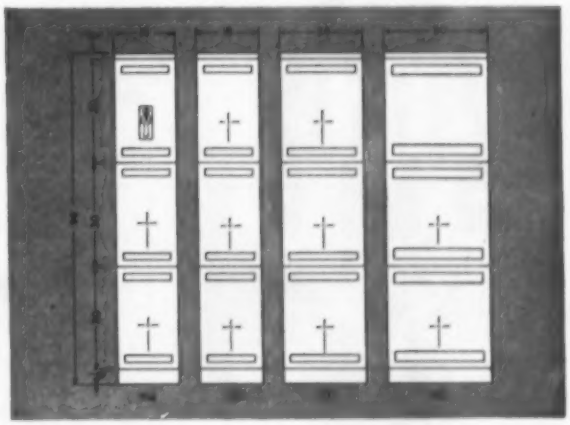
◀ Test position with doors closed now standard on new switchgear

Test position with no increase in over-all switchgear depth! This facility is by far the most convenient, most compact design on the market. It is an exclusive with I-T-E Switchgear, yet it costs no more. Additional advantages are increased safety, reduced maintenance, improved cleanliness, easier circuit identification.

New compact breaker design saves space ▶

All I-T-E Type K Circuit Breakers can now be assembled three-high. KA, KB and KC frame widths remain the same as before. However, the new KD breaker is 6 in. narrower than the old LG frame, and can be arranged in a three-high compartment, space being thus provided for instrumentation in the same frame.

For complete information, contact your nearest I-T-E field office. Or write I-T-E Circuit Breaker Company, 19th and Hamilton Sts., Phila. 30, Pa.



I-T-E CIRCUIT BREAKER COMPANY · Switchgear Division

Circle 519 on reply card for more data

it's **boiler check-up** time!

HOW ARE YOUR BLOW-OFF VALVES?

Are they drop-tight? Rugged and dependable? Easy to maintain?

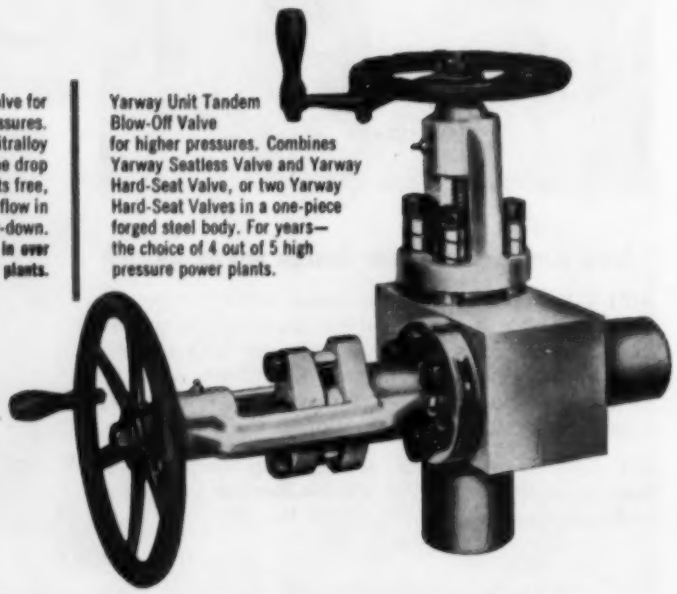
Just as important, do they have all the advantages and up-to-date improvements in materials and design of new YARWAY Blow-Off Valves?

Old YARWAY Blow-Off Valves also can be overhauled and modernized, because all YARWAY improvements are *interchangeable* with parts on earlier models.

Write today for free YARWAY Blow-Off Valve CHECK SHEET—also new YARWAY Blow-Off Valve Catalog B-426 (pressures to 400 psi) or B-434 (pressures to 2500 psi).

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

Yarway Seatless valve for low and medium pressures. Features balanced nitralloy plunger that seals line drop tight—yet permits free, unobstructed flow in blow-down. **Used in over 15,000 boiler plants.**



Yarway Unit Tandem Blow-Off Valve for higher pressures. Combines Yarway Seatless Valve and Yarway Hard-Seat Valve, or two Yarway Hard-Seat Valves in a one-piece forged steel body. For years—the choice of 4 out of 5 high pressure power plants.

YARWAY blow-off valves

Circle 520 on reply card for more data

Pulverizer aisle shows compact layout which is typical of entire powerhouse. Bank in left foreground was just installed.

Allis-Chalmers modernizes and packs

More steam capacity per cubic foot

I&P EXCLUSIVE

HAROLD A. BERGEN, Editor

INDUSTRY & POWER gratefully acknowledges the assistance of the following Allis-Chalmers men in the preparation of this story: Fred G. Schmid, chief engineer, power plant; Lloyd M. Dings, Sr., assistant superintendent, power plant; Lloyd M. Dings, Jr., superintendent of utilities; Edward Kampa, superintendent of electrical maintenance; Elmer Burrows, feedwater chemist; and Bernard Scherer, boiler room foreman.

PACKING MORE steam-producing capability per cubic foot into the old powerhouse — that's the way that Allis-Chalmers licked the knotty problem of supplying its shops with more steam though its powerhouse could not be expanded physically. The result of this power-packing is convenience, safety, and quick response to power demands.

West Allis powerhouse is in the last stages of a long-range modernization program that dates back to 1938. Allis-Chalmers' power services engineers realized then that some of their powerhouse equipment was as much as 33 years old. They called in consulting engineers, and embarked upon a program to

study their immediate and future needs. What was contemplated was a 10-year program to bring the power system abreast of modern developments.

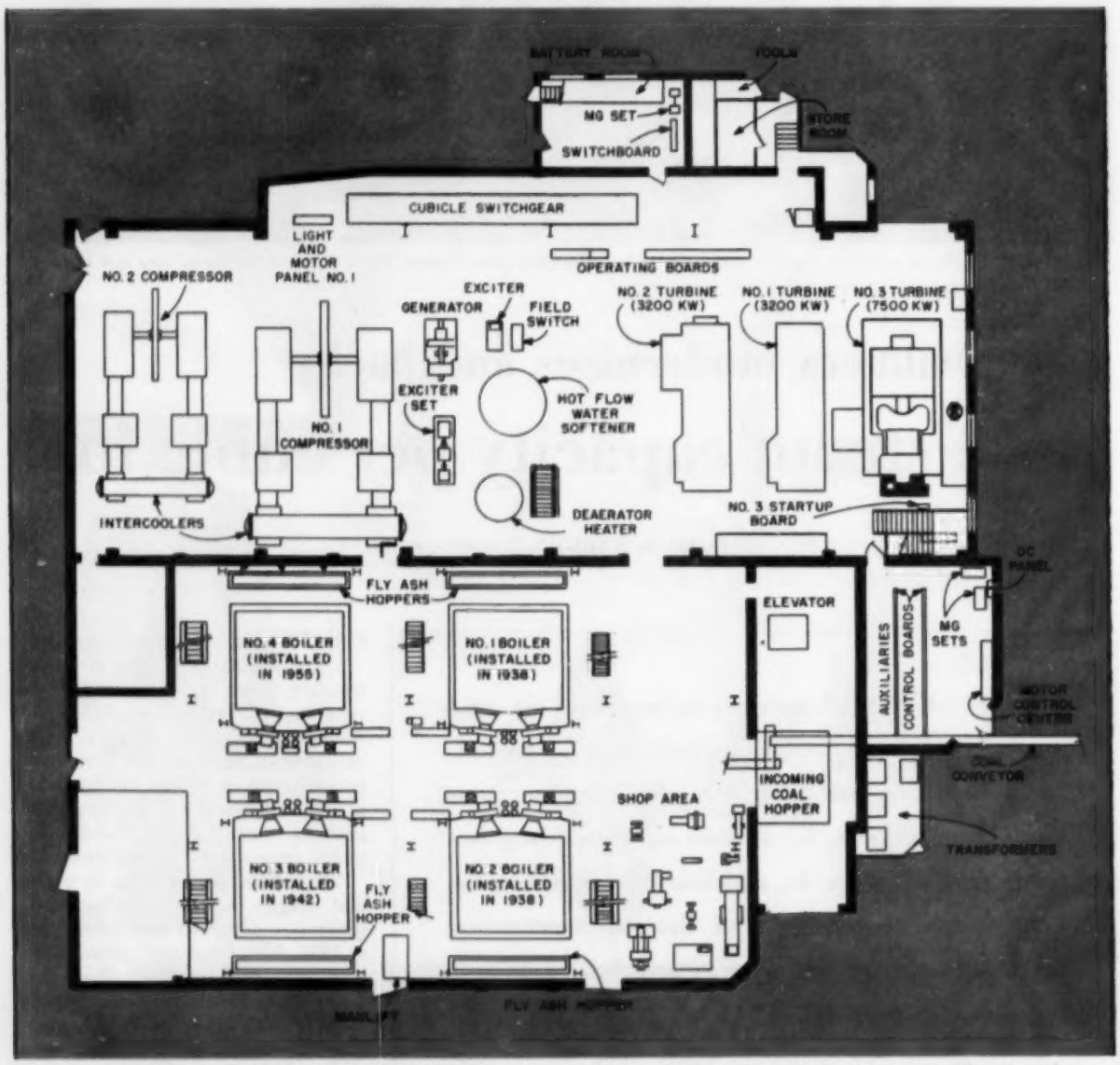
Specific objective of the program formulated in 1938 was to replace obsolete steam generating equipment that could not meet the increased steam demands then being made by production. These increasing demands were overloading the powerhouse facilities. Prominent symptoms were excessive fuel consumption, smoke, and fly ash. Reliability was not good, and maintenance was high.

In 1938, there were 12 chain-grate and underfeed stokers with a combined capacity of 300,000 pounds per hour. There were, in addition, six hand-fired units, with a combined capacity of 75,000 pounds per hour. The total steam generating capacity was 375,000 pounds per hour.

The first steps of the modernization program taken in 1938 established policy pace for those that followed through 1955. That policy was simply this: while modernizing for the sake of technical progress, get more total capability by increasing the steam-producing capacity per cubic foot of powerhouse space. This means that spare room gets scarce, that the powerhouse gets "tight like a submarine, but it's comfortable." That quotation is the wording of Fred Schmid, chief engineer of power at A-C's West Allis Works.

Battle-action boiler plant

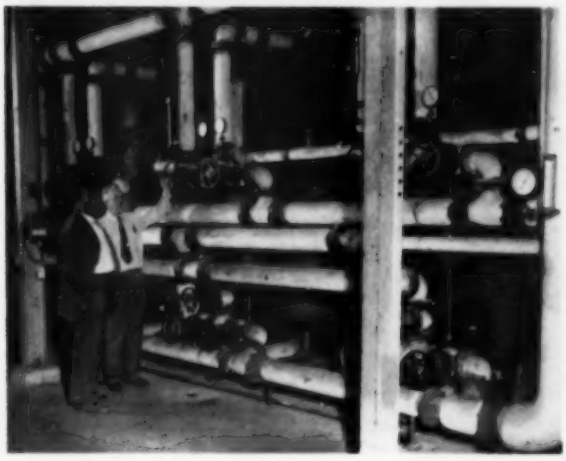
Schmid likes his compact "battle-action" boiler plant. He'll tell you, "The heart of good power plant operation is good communications. Start right where the operator stands. Put everything possible within arm's reach of his working



General arrangement plan of the main floor shows the compact layout that results in more steam per cubic foot of room.

Feedwater pump is a 10-stage Allis-Chalmers unit rated 402 gpm at 2410 ft of head. Driving motor is 400 hp.

New water treating facilities, Allis-Chalmers' own brand, treats 200 gpm to zero hardness for boiler makeup water.



station. If something happens, he can act as promptly as required.

"Take our pulverizer aisle, for example. [See photograph on page 35.] Looks like a submarine. But we packed a lot of pulverizing into a small volume of powerhouse. Anything happens, the operator can grab the lever he needs without using up time in moving too far. An overhead trolley makes for easy maintenance.

"Communication, of course, means a lot more than communication between the operator's brain and his equipment. We have a modern PA system so that the watch engineer, head fireman, and all hands can get in touch with each other fast. One announcement alerts the whole shift to the nature of any emergency. Communications are the most important thing when you are handling as much power as we have packed into this place."

In the beginning

Let's get back to the beginnings of the power-packing modernization program. In 1938, four boilers totaling 100,000-pounds-per-hour capacity were replaced by two 150,000-pounds-per-hour units. The remaining eight units then served as standby.

The new units ran 85 percent average efficiency. The boilers they replaced were only 60 percent or less efficient. In three year's operation, the new units saved $250,000 per year in straight operating costs.

Pulverized coal was selected as the fuel for the new boilers. This gave additional flexibility in that more varieties of fuel could be burned than was possible before. Only Pennsylvania and West Virginia coals could be used with the old boilers. The new units permitted efficient use of cheaper Illinois, Indiana, or West Kentucky coals.

The program begun in 1938 was soon curtailed due to World War II. However, installation of a third 150,000-pounds-per-hour boiler was completed in 1942. It was a copy of the two installed in 1938. Six old boilers remained for use as standby.

Electric load growth

To this point, electrical generating facilities had not been touched. This does not mean that the electrical load did not grow significantly. In 1939, the total connected electric motor load was 40,000 hp; by 1948 the growth rate had carried it up to 85,000 hp. (Today, the connected motor load is 110,000 hp.)

By 1948, it became apparent that any further implementation of the 1938 modernization program would require reexamination of the original plan. In 1938, for example, it had been determined that installing high-pressure steam turbine equipment for local generation would not prove economical. Process steam requirements existing at that time would not have supported an economic use factor on a high-pressure turbine-generator unit.

In 1948, however, a review of the previous study showed that process steam requirements had considerably changed. The 1948 study clearly indicated that steam requirements would justify a high-pressure, automatic extraction turbine. Studies were made of units ranging from 400 to 1500 psi and from 600 F to 900 F. Finally selected for the job was a 7500-kw extraction turbine rated 125,000 pounds per hour extraction, 850 psi, and 710 F. This modern extraction turbine was packed into the space formerly occupied by a 1000-kw condensing turbine. Again, power capability per cubic foot was increased.

It was planned that the new turbine-generator would operate 24 hours a day, seven days a week. Two older condensing turbines would be kept for the present to

Old turbine rated 1,000 kw, full condensing, (above) was removed. New turbine (right) takes up no more powerhouse space but delivers 7,500 kw plus 70,000 pounds per hour of extraction steam. All mechanical control for extraction turbine is within arm's length of control panel at stairs.

supply peak loads and power factor correction.

In spite of the increased power generating capacity provided by the new turbine, the amount of power purchased from the local utility is far greater than in 1938. In 1938, plant substation capacity was 12,000 kva. Today, it is 19,500 kva. The ratio of power generated to total power has dropped from 80 percent to 50 percent.

The bulk of the plant's power is supplied by the local utility from three independent 26,400-volt lines to a common 26,400-volt bus. Maximum reliability and flexibility is obtained for the highly fluctuating electrical and steam loads—mainly caused by demands from electrical, turbine, and pump test floors—with a minimum investment in power and steam generating equipment.

Part of the revised modernization program included taking out all pre-1938 boilers. A fourth 150,000-pounds-per-hour boiler would take up the space formerly occupied by two old units whose combined capacity was but 40,000 pounds per hour. These old boilers were underfeed types, delivering saturated steam at 150 psi and 360 F. Replacing them again meant more capacity per lineal foot of boiler aisle and more capacity per cubic foot of powerhouse.

The new boiler, No. 4, went on the line this March. The Allis-Chalmers powerhouse now has four 150,000-pounds-per-hour boilers—two installed in 1938, one installed in 1942, and one installed in 1955. The four boilers were spotted so that the firing aisle and the pulverizer aisle were both compact, in keeping with Schmid's philosophy of the battle-station powerhouse.

A couple of flash boilers, installed during World War II, bring the total powerhouse capacity to 650,000 pounds per hour. The peak steam loads range from 400,000 to 500,000 pounds per hour. The extraction turbine generates by-product electric energy and supplies steam requirements.

Adequate write-off

Installation of the fourth boiler brought about another saving of $250,000 per year on straight operating expense. Thus, the total cost of the steam generating unit and modified feedwater treatment ($2,500,000 including new coal handling equipment) will be paid off in 10 years. This is certainly adequate write-off for industrial powerhouse equipment.

Another part of the modernization program included replacing the coal handling system installed in 1906. Coal-handling capacity was thereby increased from 30 tons per hour to 100 tons per hour. A plus value of the new coal handling system is that it gave the opportunity to eliminate in-plant traffic congestion caused by coal car movements. Coal cars formerly had to be run into the powerhouse by a switch engine across a main plant thoroughfare. The volume of vehicular traffic in 1906 did not pose much of a problem then. But by 1952, though, these coal trains were holding up a great deal of traffic. The new coal handling system carries coal over the plant thoroughfares. A car puller moves the cars through the car shaker, saving $20,000 a year in switching charges.

The generator control board was also modernized. Built originally in 1912, it has been constantly revamped to keep pace with the rest of the powerhouse. Automatic synchronizers permit fast and safe operation of generators in parallel with the utility company.

Because of the success met with the type of stack built for the first two of the pulverized fuel boilers in 1938, another of the same kind was built for the new boiler—steel, with a 2-inch Gunite lining.

The old hot-lime soda softener was converted to a hot-lime softener and supplemented by a new hot Zeolite water conditioning sys-

tem, rated 200 gpm, which treats makeup water to zero hardness. Satisfactory results have been obtained up to 300 gpm.

Another new turbine auxiliary is the condenser circulating pump. Running full condensing, the pump is rated 9,000 gpm, 870 rpm, 250 hp, and 80 feet of head. When the turbine unit is running at full extraction, the pump ratings are 6,000 gpm, 695 rpm, 125 hp, and 62 feet of head.

Standby is unique problem

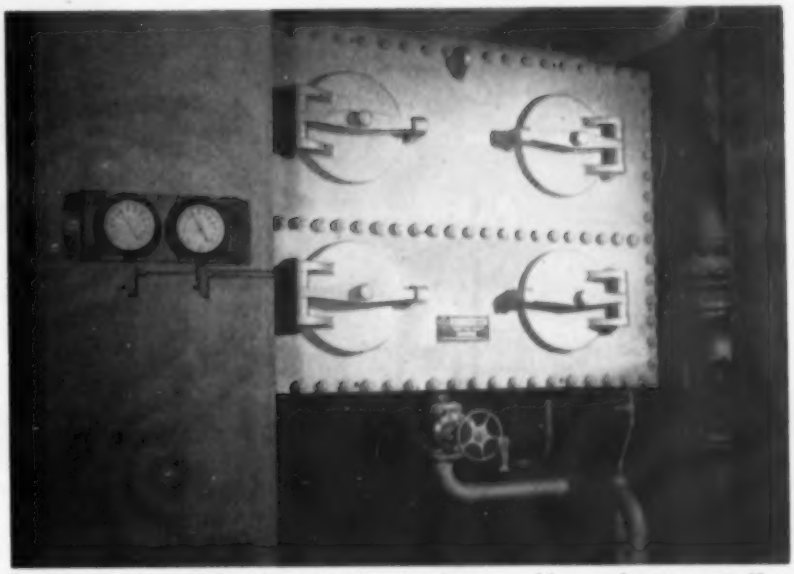
Standby problems are rather unique. Process steam requirements ordinarily are thought of in terms of steady loads for continuous cooking or similar production operations. Much of the process steam needed in Allis-Chalmers' plant, however, is rather erratic in demand. The steam may be needed in heavy, intermittent slugs for steam-operated forging presses. Even more erratic are the demands from the test floor of the turbine manufacturing building.

Thus, the powerhouse staff depends heavily on the utility to quickly make up the electrical capacity that must be converted to steam, as such, for demands like turbine testing. The fundamental consideration in Allis-Chalmers' powerhouse operation, therefore, is not so much maintaining heat balance, as it is having adequate steam capacity on call. Schmid says "All we can do is put in the capacity we need and hope for the best on the heat balance."

We are proud

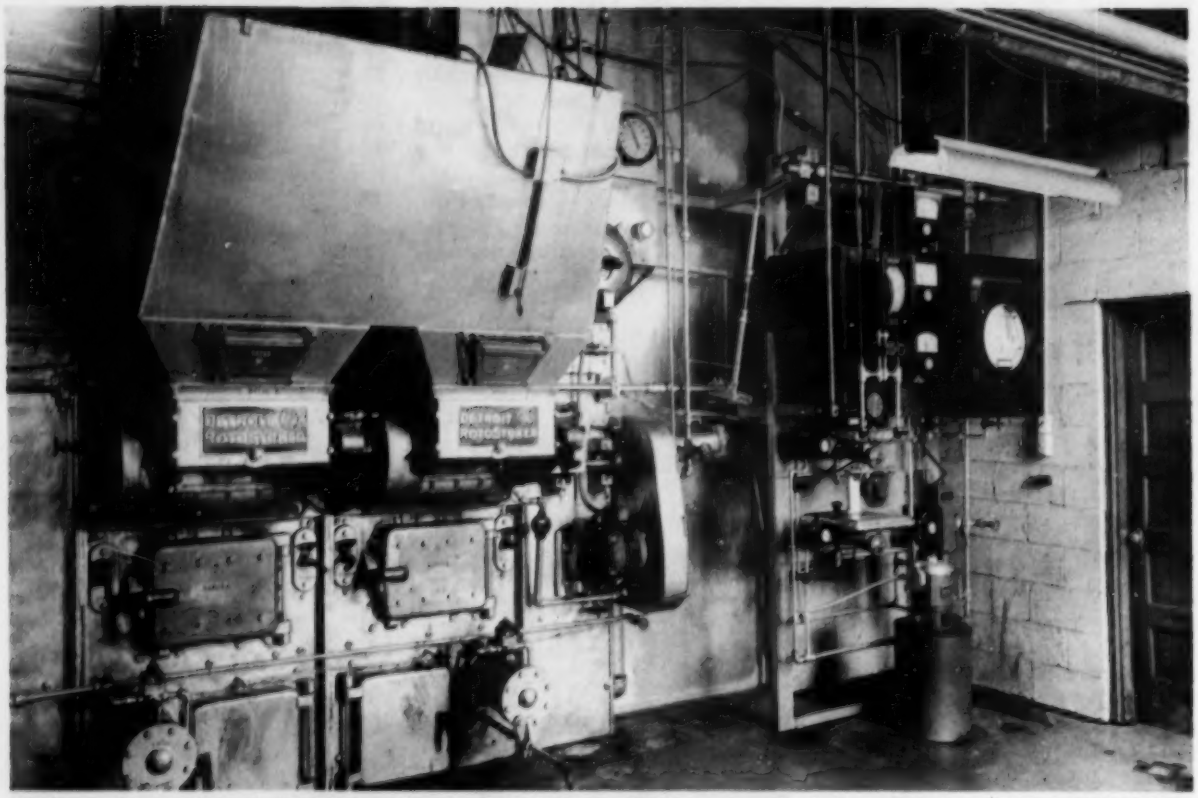
As you tour the plant, Schmid refers to his pride in his plant: "We are proud of this plant. Its compact design is extremely convenient." Standing at the automatic turbine throttling valve, he shows you how the operator can check incoming steam pressure, turbine pressures in the various stages, condenser auxiliaries, lubrication, and rpm. All valves for turbine startup can be manipulated standing at this one station. From standstill to the point where the turbine is running under governor control, the operator need step but two feet from his station in getting the turbine up to speed.

Once the turbine is spinning under governor control, the operator can move over to the other side of the turbine room where controls for putting it on the line (electrically) are similarly concentrated. This arrangement is not only convenient, it is safe. Schmid sums it up: "We have increased capacity and have put everything within finger-tip reach of our operators. The operator knows what's doing at all times. This is the best insurance you can buy."



Top-feed, bottom-out surface condenser replaces an older condensing unit. New one gets high efficiency by putting coldest water through next to hottest steam.

New steam generator, rated 150,000 pounds per hour, was installed (left foreground) in the same amount of powerhouse space formerly occupied by old, underfeed boilers (far right) whose combined capacity was but 40,000 pounds of steam per hour.



Stoker and control panel of Wickes outdoor packaged A type 250 hp water-tube boiler are enclosed in a small building.

How we went about

Selecting a boiler control system

I&P EXCLUSIVE

D. W. KARGER
Chief Plant and Industrial Engineer
The Magnavox Company

A MOST VITAL part of any boiler installation is the control system. After we had decided to install a new packaged outdoor A-type boiler with a spreader stoker in our Fort Wayne, Indiana plant we had the equally important decision to make about the control system to be used. Instruments and automatic controls are two distinct types of equipment, each designed for a specific purpose. The instruments serve as guides for the boiler plant personnel and also provide management with information for calculating efficiencies and operating costs. Automatic controls on the other hand perform the actual regulation of the equipment to maintain this high efficiency.

There are four basic types of control systems that we could have used, which are applicable to practically all types of firing equipment; manual controls, positioning controls, semiproportioning controls, and fully proportioning controls.

Manual control and positioning control are essentially alike. Full manual control means that the firemen must adjust levers, open doors, regulate dampers, and open or close valves by hand to control the amount of fuel and air entering and leaving the boiler. Steam pressure, however, is difficult to maintain efficiently.

Positioning controls require the same degree of skill and knowledge in the fireman or boiler operator as do manual controls. The only real difference is that he can make the adjustments from a remote point, preferably adjacent to the stoker installation itself. Positioning controls have only one automatic feature. They will start and stop fuel and air injection in relation to boil-

er pressure. Changing the proportion of fuel and air with respect to each other and to the boiler pressure is still a manual adjustment.

Semiproportioning controls automatically adjust the stoker feed to maintain boiler pressure. Insofar as the spreader stoker is concerned, this control regulates the damper adjustments on the forced draft fans to provide the proper amount of air for the amount of coal being fed into the boiler. It indirectly regulates the amount of air in proportion to the fuel bed thickness.

Needs manual reset

This type of control is limited by the fact that it must be reset manually for different major load conditions. Setting the control system for these major load variations not only means adjusting the control system itself but also means adjusting the related manual settings on the stoker. These controls require resetting only at infrequent intervals, however. A great deal of experimentation and measurement with instruments — such as CO_2 meters and air flow meters — is required before proper setting points can be determined for the various major load conditions.

The fourth and more expensive type of control system is fully proportioning, which also takes into account the actual air flow. Once adjusted, it automatically sets itself to the proper point for maximum efficiency relative to load.

Chose semiproportioning type

The control system selected for our new boiler was a semiproportioning type with dampers and other apparatus operated by hydraulic cylinders. This system maintains furnace draft by regulation of a damper at a control point of ½ in.wg. Steam pressure above or below the control point of 80 psig actuates the master hydraulic regulating cylinder, which in turn operates directly on the stoker coal feed. This particular cylinder also modifies another regulator that controls the amount of forced draft by operating the forced draft fan damper. Air pressure measurements are also fed into this forced draft regulator from two different points in the boiler.

By integrating these three pieces of information (the coal feed from the master cylinder and the two air pressure measurements) it is possible for this regulator to set the forced draft fan at the correct point for the amount of coal being fed. Manual adjustments must be made for major load variations to permit the system to properly proportion air flow to coal feed. Once reset, the system again functions automatically for minor variations in the steam load.

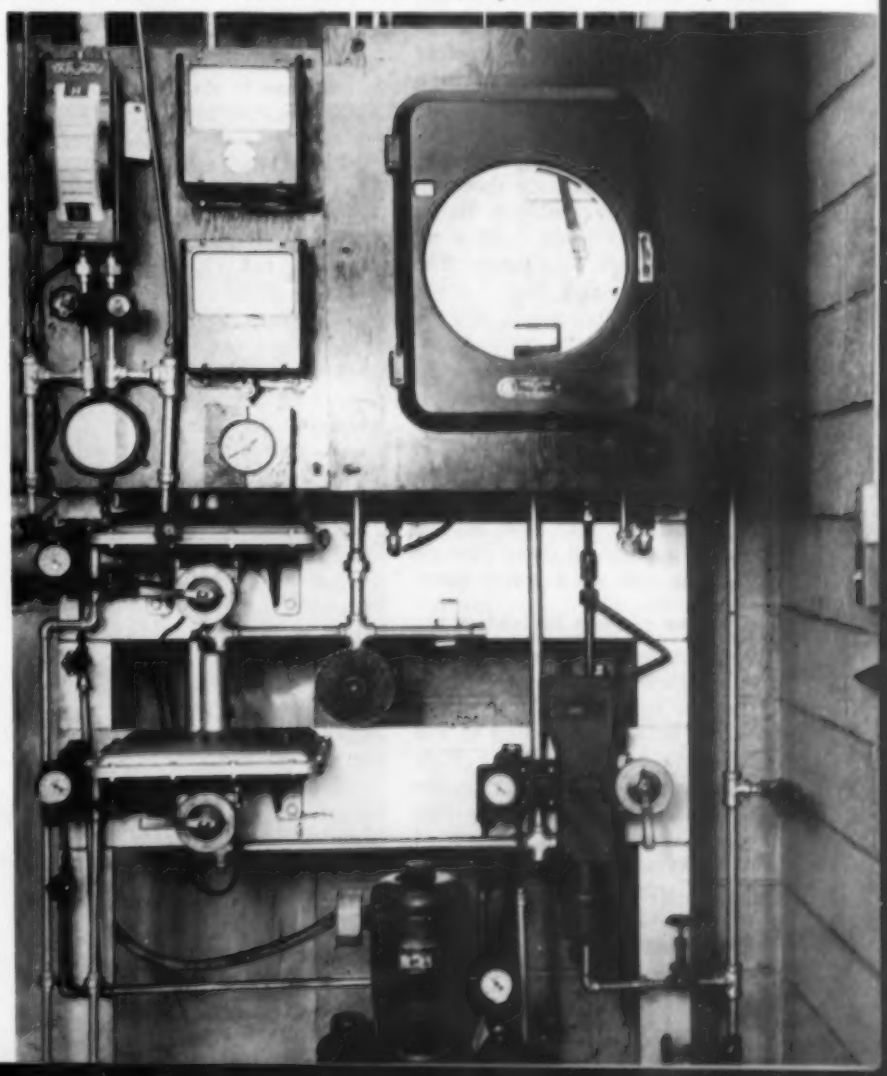
It is extremely important that the control system supplier has adequate field engineering service available to help you properly install the control, set it, and provide technical advice. The control installation engineer must work with the stoker installation engineer. Timing of their work on the equipment is important.

We performed our own installation by following drawings supplied to the control system maker. We had had some previous experience with this manufacturer's positioning controls, since they were installed on our existing boilers. This made installation relatively easy. Engineering service was made available at the first starting of the boiler to put the controls into proper operation. We know from experience that this kind of help is very much needed unless a very experienced staff is available.

Needs six months operation

It is our opinion that, regardless of the control system selected, final adjustments and maximum efficiency can be achieved only after the unit has operated for approximately six months. Recorded data should be taken during this period, analyzed, and translated into spe-

Home-made panel houses all control instruments above hydraulic pump. Electrical switchboxes are mounted on a similar panel at other side of boiler.



cific operating instructions for the fireman if maximum efficiency is to be obtained and maintained.

General instrumentation

Perhaps the most important instrument we installed was a recording air flow-steam flow meter. This was required in order to get a front office indication of the type of operation being carried out on the boiler. In general terms, the air flow through the boiler should vary directly as the steam flow. If it does not do so, it indicates that the control system is not functioning properly or that the firemen are guilty of poor operation. Our instrument also records stack or flue gas temperature. By examination of the charts available from this instrument, the time of ash dumping and other major interruptions to the normal operation can be checked.

An alternative efficiency metering device is the feedwater flow meter. Positive displacement hot water meters are often used, but they are prone to higher maintenance requirements. We therefore decided that the investment in a recording steam flow-air flow meter would be justified.

Other instruments mounted on our control panel include three direct-reading draft gages, a boiler pressure gage, a clock, and a remote water level indicator. The draft gages serve as a double check on the air flow indication, and on the correctness of the control system operating position.

The remote water level indicator can be purchased with high- and low-level water alarm. On our boiler, the alarm and automatic cutoffs for high or low water levels were integrated into the control system. We installed them directly at the standard sight water glass.

Had to use remote indicator

We installed a remote water level indicator because we could not see the sight glass. The roof of the small building attached to the front of the boiler was only high enough to provide housing for the stoker. Another solution to this problem of remote indication of water level is to use a periscope, with two large mirrors and an enclosed housing going up through the roof to the sight glass. A steam-whistle, low-water alarm was supplied with the boiler.

Feedwater regulation can be manual or automatic. For any modern plant, it should be automatic.

There are two basic types of feedwater injection. Each is a part of the control or regulation system. ONE type of injection is proportional to load, and essentially maintains the boiler water level at a constant point. This method varies the speed of the pump as the load shifts, always striving to maintain a constant water level in the boiler. The other method of injection uses a constant rate of injection and strives to maintain water level by turning the system on and off.

The feedwater regulation system can take several forms. It may derive its regulation from floats, bimetallic elements, or other devices.

Chose bimetallic regulator

We chose a regulator of a bimetallic type. This bimetallic element operates a control arm up and down, which opens and closes a valve placed in the feedwater line in response to steam flow.

An essential part of the regulator system is the feedwater pump governor which regulates the steam flow into the steam feedwater pump. The regulator measures the difference in water pressure on both sides of the feedwater valve and transmits this intelligence to the governor.

There are two major power supplies for feedwater pumps: electric motors and steam power. The electric-motor operated pump usually does not provide a continuous and proportioned flow into the boiler, but this can be remedied by using a variable speed motor or drive.

A steam-powered piston pump was selected because we wanted to minimize the thermal shock to the boiler that might occur if a constant delivery pump were used. With constant delivery the rate of flow must equal or be slightly larger than maximum flow requirements. The exhaust of the steam pump is piped directly into our low-pressure steam heater and is used in our heating system.

It is advisable that the manufacturer's engineers be consulted in developing a piping diagram for the installation of this pump. The position of the pump in relation to deaerating or similar equipment must be considered in order to prevent flashing of the feedwater in the pump itself. The proper location and size of the air cushion must also be decided. It is well to consider future installation of additional pumps, either for standby service or for additional boilers.

A sizable portion of our process steam requirement is related to the need for large quantities of distilled water. Two large steam condensers are in use for this purpose, but we expect to replace them soon with compression stills.

The distilled water must be extremely pure, high in electrical resistance and low in both organic and inorganic solid content. No contamination of the steam from the boiler can be permitted. For this reason, we installed an adjustable automatic blowdown valve to help hold the solids to a permissible limit. This automatic blowdown valve was piped directly to the existing blowdown chamber that is part of the regular powerhouse installation. Provision was also made for manual blowdown, as some manual blowdown is always required. The regulator purchased will provide blowdown adjustments from 38 gallons per hour to 185 gallons per hour.

Keep manufacturer informed

The boiler manufacturer was informed of the type of blowdown equipment to be installed, and he was able to position the blowdown leg for optimum results.

The more the boiler manufacturer knows about such auxiliaries to be installed, the more he can adapt the boiler to your requirements and offer advice concerning special items to be considered. Plant engineers should look well ahead when replacing boiler plants. Due consideration should be given to working conditions and operating costs. Future costs are a big factor in selling a replacement schedule to management. The investment in sufficient automatic controls to run the powerhouse efficiently provides very satisfactory returns, particularly when the controls are planned with an eye to future plant expansion with its heavier steam requirements.

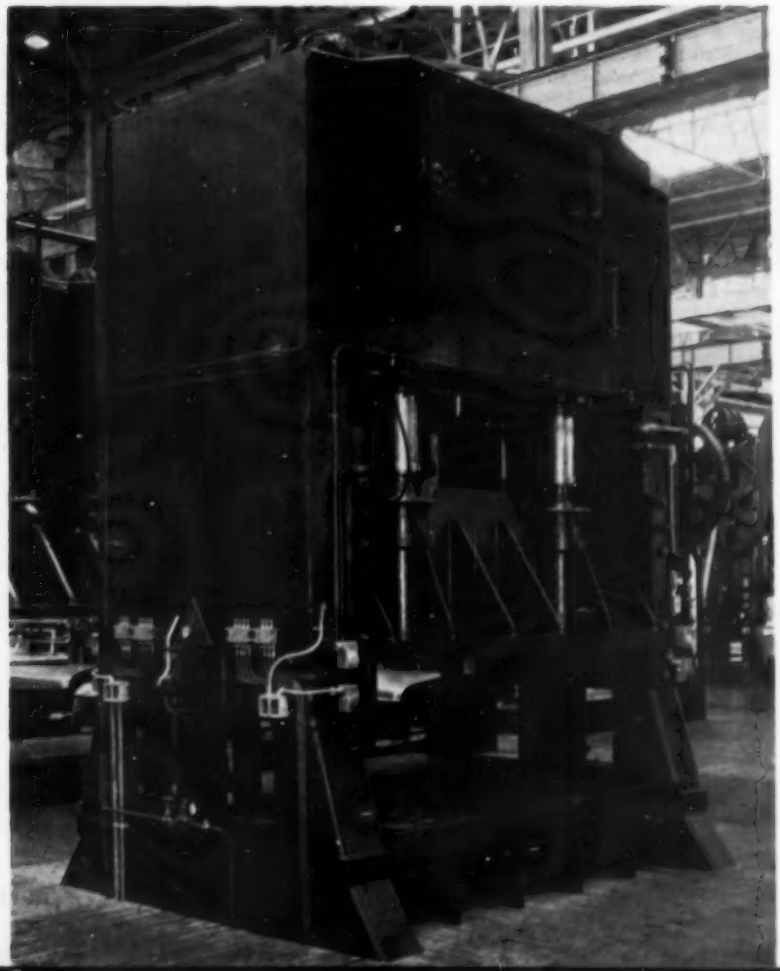
What those additives do for Industrial lubricants

ELIAS KIMMEL and BERNARD BERKELEY
Oils and Lubricants Section
Foster D. Snell, Inc.

I&P EXCLUSIVE

Elias Kimmel (top, right) is section leader, oils and lubricants section, product development department. He was a research chemist in general physical chemistry with the general chemical division, Allied Chemical and Dye Corporation. He is a member of the American Chemical Society, Phi Lambda Upsilon, and Sigma Xi. He has a BS degree in chemistry from Long Island University and a PhD degree in physical chemistry from the Polytechnic Institute of Brooklyn.

Bernard Berkeley (immediately above) is assistant director, oils and lubricants section, product development department. He has worked at Foster D. Snell on research and development in chemical specialties for industry—including gasoline and oil additives, watch oil lubricants, textile lubricants and coning oils, rubber lubricants, molybdenum disulphide and graphite dispersions, and hydraulic fluids. He is a member of the American Chemical Society, American Institute of Chemists, and Phi Lambda Upsilon.

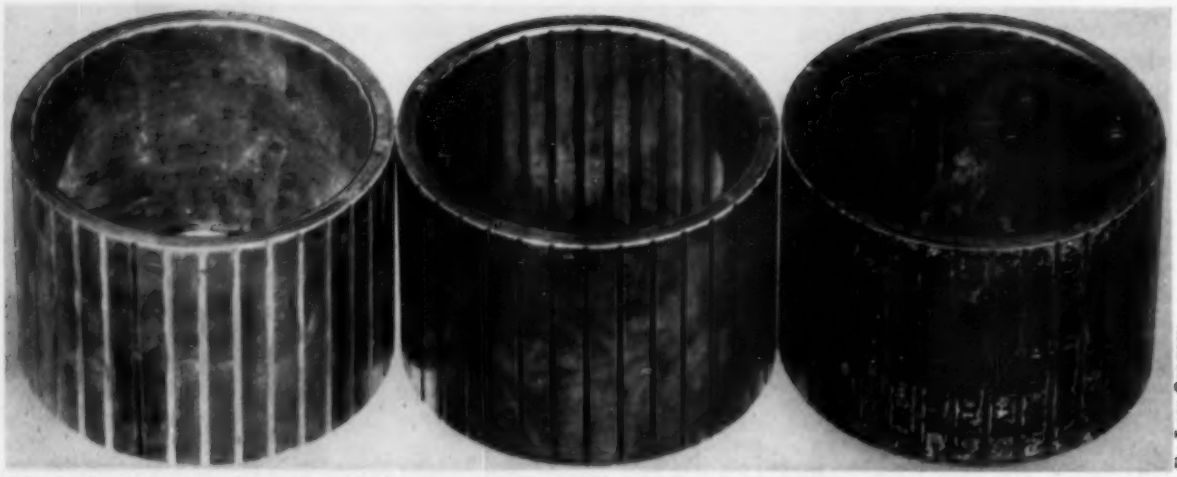


Importance of lubrication is stressed by popularity of centralized lubrication in the modern industrial plant.

PRESENT-DAY LUBRICANTS must meet increasingly higher performance standards. Higher speeds, higher loads, and higher operating temperatures imposed on industrial lubrication systems have greatly increased the number of problems facing those who must buy industrial lubricants.

Among the problems that must be recognized in choosing lubricants are thermal decomposition and oxidation of the lubricant (accompanied by bearing corrosion and formation of sludges and sediments), and of increased wear at friction points. In many instances, the shortcomings of existing lubricants rather than of equipment design are the limiting factors in improving equipment efficiency, increasing equipment speed, or increasing power output delivered by the equipment.

In many cases, lubricants must be useful over relatively larger temperature ranges than before. Lubricants that have suitable fluidities at their normal operating temperatures cannot be so viscous (and certainly not solid) at cooler ambient temperatures as to hinder starting of the machine. This problem assumes great importance when oper-



The Texas Company

Effects of additive reactions after 300 hours operation. Bushing (left) is bright, clean, worn. Bushing (center) developed thin film, providing durable wearing surface. Bushing (right) developed thick film that tore off with metal.

ating temperatures become very high or when environmental temperatures are extremely low — such as when machinery may be subject to the extremes of no-load to full-load operating temperatures while also being subject to the extremes of outdoor temperatures.

Additives are best hope

Development of synthetic lubricating fluids—such as the diesters, polyalkylene glycols and derivatives, and silicones—has given us a greater variety of base fluids to choose from when developing a lubricant for a specific purpose. It has been apparent for some time, however, that only rarely do any of the available basic fluids, petroleum or synthetic, possess all of the desirable properties for a given lubrication requirement. Chemical additives are, at the present time, our best possible means of compensating for the inadequacies of the basic lubricant vehicles. These additives are chemical compounds, seldom having any lubricating properties of their own. They are capable, in relatively small concentrations, of favorably affecting the behavior and specific properties of the base lubricant.

Additives are usually present to the extent of just a few percent of the formulated lubricant. Occasionally they constitute only a fraction of a percent. In some cases, though, they may constitute higher than 20 percent of the total composition.

Most of the additives incorporated in industrial lubricating oils can be placed into one or more of the following categories:

¶ Oxidation inhibitors
¶ Detergents
¶ Rust inhibitors
¶ Wear prevention and extreme pressure additives
¶ Viscosity index improvers
¶ Pour-point depressants

Oxidation inhibitors

All lubricants that are even partially hydrocarbon in structure are subject to chemical attack by oxygen if allowed to remain in contact with air at elevated temperatures for extended periods of time. As the operating temperatures of machinery increase, the rate at which a hydrocarbon lubricant is attacked increases quite rapidly—approximately doubling for each 20-F rise in temperature.

The lubricated machine, in effect, assumes the role of a reaction vessel. It contributes thermal energy and physical agitation for this undesirable oxidation reaction. In addition, our modern machinery also supplies powerful metal catalysts that can accelerate the reaction. These crop up in the metals of construction and bearing materials. Iron, copper, manganese, and lead are the most active of these catalytic materials. They can considerably increase the rate of oil deterioration.

If the only result of oil oxidation were the consumption of lubricant, it might not be as serious a problem as it actually is. The end products of this process are, however, highly objectionable in themselves. Organic acids formed from some types of lubricants are highly corrosive to bearing materials. Condensation products from other types of lubricants change the viscosity of the lubricant. Oil-insoluble sludges and varnishes are created. These lead to decreased efficiency and accelerated wearing of friction parts.

According to the most recent theories, oxidation inhibitors now in common use exert their benefits through two possible mechanisms. One of these mechanisms involves destruction of the peroxides that are the primary oxidation products, and which would accelerate deterioration of the oil if allowed to build up to an appreciable concentration. The other is a process of deactivating the catalytic metal surfaces by forming an adsorbed coating on them. This coating nullifies the effect of metal ions dissolved in the oil—that is, it behaves as a catalyst poison.

Amines for turbine oils

The known oxidation inhibitors may be divided into the following types: sulfur compounds; phosphorous compounds; amines, quinones, and phenol derivatives; and mixed types. Compounds of selenium (which is an element similar to sulfur in chemical behavior) have been used, but not to any appreciable extent. Not much is known about their usefulness and applicability. The group of inhibitors containing amines, quinones, and phenols have long found application in highly refined special purpose oils—such as turbine oils. They are now finding extensive use in synthetic lubricants.

In an attempt to develop more effective inhibitors, compounds containing two of the active components found in the foregoing classes of anti-oxidants have been produced. In general, these mixed-type inhibitors have been found to be more effective than corresponding single-component ones. The best known of

these are the sulfur-phosphorous compounds. Reactions with a variety of unsaturated compounds such as fatty acids, fatty esters, terpenes, and polybutenes yield numerous other effective classes of oxidation inhibitors.

The number of available anti-oxidant additives is quite large. Selection of the proper one depends on the base lubricant and on the job to be done. Note that these additives are classed as inhibitors. They do not completely prevent oxidation. Under normal operating conditions, however, they reduce it considerably. They are consumed during this process of inhibition. Under unusually severe conditions, this consumption may proceed at an appreciable rate, shortening the useful life of the lubricant. At sufficiently high temperatures, an anti-oxidant additive will completely lose its inhibiting properties.

Detergents combat sludges

Oxidation inhibitors cannot always completely prevent the formation of solid oxidation products. It is highly desirable to keep these materials (as well as any other solid contaminants, such as dust and soot) from forming sludges or gumming up moving parts. Detergents must be blended into the lubricants to keep these fine particles in suspension. Generally speaking, the detergents (actually dispersants) that are used are analagous to those used in aqueous systems.

While there are many satisfactory detergents, many strongly accelerate oxidation of oil. The sulfonate type of detergents are, currently, the most commonly employed detergents. They are oxidation promoters, but are not as active in accelerating oxidation as are other categories of detergents.

There are a few effective detergents that have mild anti-oxidant rather than pro-oxidant properties. Some of the most important of these are the alkaline-earth salts of the phenol sulfides. The fact that so many of the more commonly used detergents are oxidation catalysts makes it imperative that proper consideration be given to these effects when considering lubricants with detergent additives.

Rust inhibitors

In lubrication systems subject to the effects of condensing water (a particularly well-known example is steam turbine systems), the lubricating oil must have exceptionally good rust-inhibiting properties. The highly refined base oils normally used in steam turbine systems lubricants actually have very poor rust-inhibiting powers in the absence of additives. They are easily displaced from metal surfaces by any water which may be present, leaving these surfaces unprotected and very susceptible to rusting. Rust-inhibiting additives are polar compounds that have an affinity for, and form an adsorbed film on, iron surfaces. These films repel water. The lubricant oils are readily able to set on the metal surfaces.

Some of the rust inhibitors are quite similar to the polar compounds employed as detergents. Similar precautions must be observed.

When choosing a lubricant with a rust-inhibitor additive, great care must be exercised. The degree of protection needed and the operating temperature of the oil must be carefully considered. Compounds of any given type give greater protection as their molecular weight becomes greater. Solubilities, however, generally decrease in the same order. It may not be possible to obtain desirable concentrations if the molecular weight is too high.

Normally, the concentration of a rust inhibitor needed increases with operating temperature. Thus, where 0.01 percent of an inhibitor gives sufficient protection at 100 F, twenty or thirty times this concentration will most likely be necessary for the same degree of protection at 200 F.

Additives resist wear

Under the conditions normally existing at friction points in machinery, opposing metal parts are separated by a relatively thick film of oil. Wear due to friction is very low. There are times (as in the starting or stopping of a machine) when the speed of moving parts may not be sufficient, however, to support this type of lubrication. Lubricant may be squeezed out from between moving parts, leaving a film of only molecular dimensions to prevent excessive wear of seizing. Machine parts undergoing sliding motions are constantly subject to this boundary-film type of lubrication when operating in short reciprocating motions or operating under extreme pressure. Base lubricants now in common use often fail to provide the necessary lubrication in these cases.

Additives are necessary that have a strong affinity for the surfaces to be lubricated, and that will provide a tenacious, friction-reducing film at the proper pressures and temperatures. These additives generally react with the metal surfaces at normal operating temperatures, or at the local temperatures which prevail under extreme conditions, to form a resistant film that prevents welding of friction-heated parts. Such welding on a microscopic scale would eventually manifest itself as wear. On a larger scale, it would show up as seizing.

Because these additives are relatively reactive compounds that actually exert their benefit through somewhat corrosive means, they should not be specified indiscriminately. Extensive testing is necessary to decide whether corrosion caused by the additive is compensated by the alleviation of wear due to frictional causes existing in its absence. In this regard, friction measurements can be quite misleading because reduced friction is not necessarily a sign of reduced wear. Reduced friction is very often accompanied by a continual process of surface reaction and erosion of reaction products. While friction may be reduced, wear actually may be accelerated by an improper choice of specific additives.

Viscosity index improvers

For most purposes, it is advantageous to use a lubricating oil that does not greatly change its viscosity with changes in temperature. For economic or practical reasons, it is not always possible to find a base lubricant with the proper temperature-viscosity characteristics. It is then often possible to improve this property by use of an additive.

Viscosity index, a quantity calculated from the viscosity of a liquid at 100 F and 210 F, is inversely related to the viscosity change that takes place between these two temperatures. The less the change, the higher the viscosity index, and the greater the temperature range over which the lubricant may be used.

Viscosity index improvers in current use are mostly polymeric materials that, used in rather small quantities, tend to increase the viscosity of lubricants in which they are dissolved. This increase is proportionally greater at higher temperatures than at lower ones, resulting in an increase in the viscosity index. While numerous compounds may be used as viscosity index improvers, only a few are used widely in commercial practice.

The use of viscosity index improvers has a number of limitations. Undesirable, lighter, more-volatile base fluids must be used in the case of hydrocarbon lubricants to avoid undue increase in viscosity at lower temperatures. A more serious consideration is that of chemical de-

terioration of the additive under operating conditions. Vigorous agitation and high shearing stresses tend to break down the large polymer molecules of the additive and reduce their effect. It is necessary, therefore, to carefully determine the stability of an additive under operating conditions before specifying it in a lubricant.

Pour-point depressants

Pour-point depressants are used exclusively in paraffin oils derived from wax-bearing crudes. Large crystals of wax that normally crystallize from these oils as the temperature is lowered form a solid spongy network that traps the remaining liquid. This network prevents the flow of oil at temperatures at which the oil is still quite fluid and at which there is relatively little solid matter present.

The addition of a pour-point depressant does not substantially lower the temperature at which solid begins to precipitate. By greatly reducing the size of these precipitating wax crystals, however, it prevents the formation of the wax sponge. It thereby permits the lubricant to flow until reaching some lower temperature, at which the remaining fluid has become an extremely small quantity or has become too viscous to flow perceptibly. Useful temperature range of the oil is thus extended. The use of these additives permits lowering the pour-point of these lubricants without resorting to excessive refining to completely dewax the oil.

Anti-foaming agents are used, particularly in circulating oil systems, whenever foaming may become a serious problem. Foaming is usually most serious among the more viscous oils. It is greatly accelerated by additives, particularly detergents. A number of anti-foaming additives are available. Silicones are extremely effective in preventing foaming when present in minute concentrations.

So-called tackiness agents are employed in some oils to prevent excessive leakage from bearings that have no mechanical oil retainers. Lubricants containing these additives also find use in industrial applications where dripping or spattering oil would be serious.

Bear in mind that mere addition of a number of additives of the proper category to an oil constitutes no assurance of producing a lubricant with desirable characteristics. The effect of one inhibitor on a lubricant property (other than the one to which it is directed) may be undesirable. This effect has been noted in the effect of some detergents on the oxidation properties of oils.

Additives may be incompatible

Furthermore, some mixtures of additives are incompatible and may react with each other. Solid matter sometimes may be deposited out after the oil has stood a while.

Multitudes of lubrication problems can be solved or materially reduced by the proper use of additives. To obtain the maximum benefit from their use, however, they must be added to the best available oils of known and predictable physical and chemical properties. Additives are not meant to compensate for the presence of harmful impurities or for inherently undesirable properties of the basic lubricating fluid. No amount of inhibitor can long protect an oil which has any of these shortcomings.

I & P quotations . . . .

Automation as the engineer sees it

IN TECHNICAL terms, and limiting the definition simply to the mechanical aspects, automation is the addition of the tools of programming and computing to the well used tools of mechanization: mechanics, hydraulics, and pneumatics. . . .

To the engineer, then, automation relates merely to the machine; but the engineer can see that the utilization of the machine may have far reaching economic effects. This may become a disturbing factor in the engineer's thinking, for he is not certain that what he is building is beneficial to society or may react to the detriment of mankind. It becomes advisable, I believe, for the engineer to broaden his thinking, so that he may see the "animal" as a whole, and not as a mere machine. Automatic machinery, or the automatic factory, or office, when seen in the proper perspective, becomes one result of automation, in this broader concept, and not a primary cause of automation. . . .

I cannot stress too often that automation is not a thing of the future. It is here and is rapidly increasing in scope. We must talk of it in terms of the present.

There are instances where consumer products plants are now turning out appliances at the rate of one every 30 seconds, with 2500 machines strung over 25 miles of conveyors. . . . As many as three million accounts of a national insurance company are now serviced by machines using electronic principles. . . . The surface has hardly been scratched. . . .

In industry automatic production is based on the idea of unbroken motion and involves the combination of several piece-meal operations into one unit. By using the "building block" technique, you link a number of automatic systems, gradually broadening the process until the completely automatic plant is within striking distance.

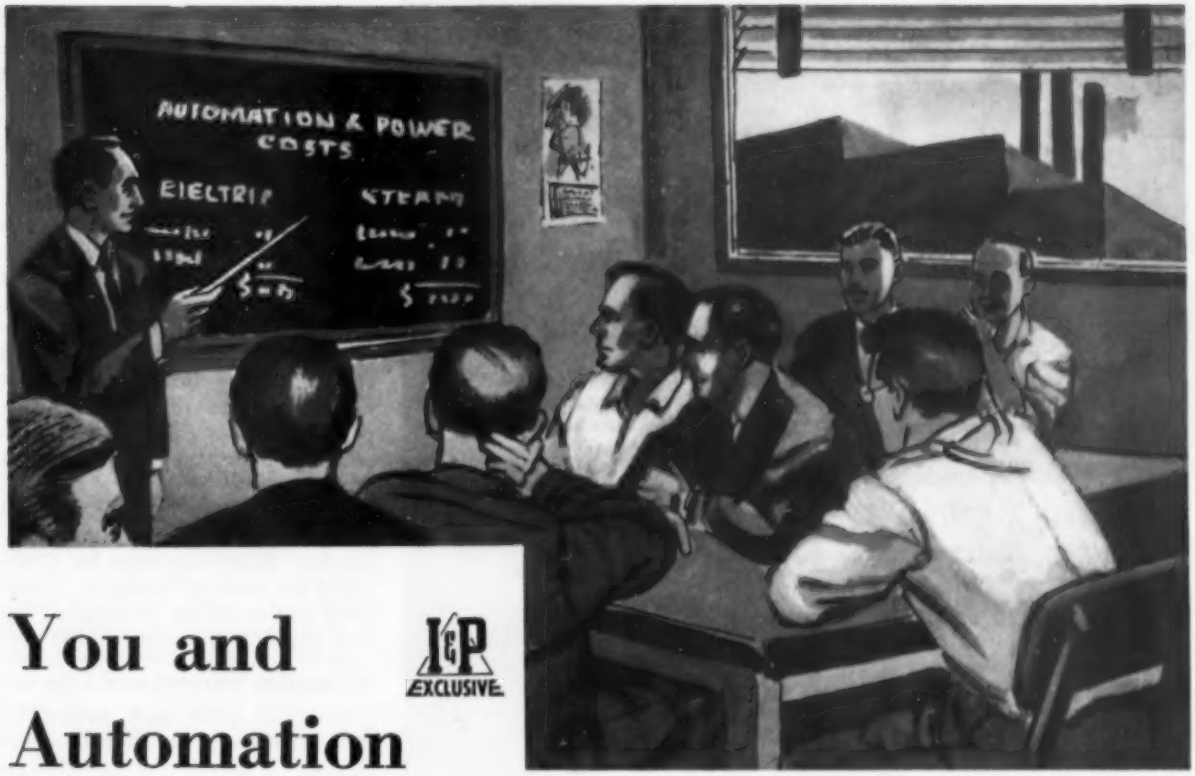
The ultimate, of course, would be the pushbutton type of operation covering inspection, assembly, test, packaging, and a raft of other services in which no human help is needed. We know of no completely automatic factory operating on a large-scale basis at the present time. The closest approach to it is the processing of some fluids — in the chemical, oil and food industries — where only elaborate piping, pumping, and time cycling is required. One leading organization of chemical producers has estimated that instruments and control mechanisms now commercially available can supply 90 percent of the needs of the modern chemical plant.

This is illustrative of the great things possible with automation. But let us remember that while things can be done, it doesn't mean they will be done. . . .

The key to widespread use of automation is flexibility. The ability to switch quickly from one type of assembly to another, with a minimum of downtime on equipment, is a prime requirement. . . .

The engineer as a member of the management team must help assure that we do not become so wrapped up in the magic of the word "automation" that we ignore some of the areas that can provide equally important rewards to our economy and our standard of living.

W. R. G. Baker, Vice President
General Electric Company



You and Automation

I&P EXCLUSIVE

C. E. EVANSON

President and General Manager, T A B Engineers, Inc.

Power services as affected by automatic production is a "natural" for C. E. Evanson. The firm he heads has been working in this field since World War II. He is the originator of the Automation Rating Chart, a device that assists engineers in evaluating automation for their own problems. Evanson is a graduate mechanical engineer (Illinois Institute of Technology.) He belongs to ASME, SAME, and ASTE. He is listed in Who's Who in Engineering. He has been on the staff of Dole Valve, Prismacolor, Link Belt, and Barnes & Reinecke. Evanson is well-experienced in engineering circles as an author and speaker on Automation.

POWER SERVICES ENGINEERS today face new and complex problems—problems brought about by the revolution (or evolution) in industry called Automation. There are many opinions about the definition of Automation. Basically, though, it is advanced mechanization through which production is increased, through which quality standards are raised and controlled, and through which production costs are cut by means of automatic machines, conveyor systems, electronic controls, feedback systems, and the brain-like computers.

Automation results in completely automatic production. Machines operate continuously to do most or all of the heavy drudgery previously performed by employees. Automation is a concept—a way of thinking—whereby all of the manufacturing processes are coordinated and synchronized to produce finished products from raw materials. Automation not only replaces the muscle of man, but also replaces a part of the mind of man.

But what about you, the engineer responsible for the power services that sustain production: steam, electricity, air, water, power transmission, waste treatment, and so on? The company and its employees may be benefiting greatly from the marvels of continuous processing, automatic materials handling, automatic transfer machines, servomechanisms, and feedback controls. Such achievements in manufacture, however, bring on special problems for you.

What about power services?

Among the important facilities and services you supply is power. In Automation, production is con-

Power services maintenance orders cannot pile up (above) in Automated plants, but must be scheduled (below) as carefully as production itself. In Automation, power becomes a raw material.

tinuous throughout one, two, or even three shifts. This requires not only adequate quantities of power, but a steady flow of power.

It is your responsibility, furthermore, to be certain not only that adequate power is available, but that it is distributed and used as efficiently as possible. The reason is quite basic.

More power per unit

Automated plants require much more power per unit of production than do conventional plants. As the total cost of the power services goes up and the total cost of direct labor goes down, a larger and larger proportion of the end product's unit cost is going to be power. The cost of producing the company's product, therefore, is shifted in great measure from the responsibility of the production engineer to the responsibility of the power services engineer. The costs of production are quite importantly affected by the competence with which the plant engineer performs when Automation comes on the scene.

Key to automation success

The greatest transition in your working-day functions and responsibilities will have to do with the maintenance of the complex mechanisms characteristic of Automation. In the good old days of the oil can and wrench, your men were more or less trouble shooters—answering distress calls when breakdowns occurred out in the plant.

You would, naturally, answer these calls as soon as you could. But the downtime of a machine or department frequently amounted to several days or weeks, even for minor repairs. Production went on during these periods as best it could. The employees immediately affected were assigned to other work, such as building inventory in other phases of production since other departments kept going.

With Automation, the entire line is mechanized. Production continues without interruption from one operation to the next. Furthermore, the line is synchronized perfectly at the highest possible speed. When such an Automated line has a breakdown, the problem is much more serious because it means that the entire line must be shut down. (Unless auxiliary means of handling product flow can be provided economically). Employees cannot be assigned to other work. The production loss can be great—depending upon the length of the downtime.

In an Automated plant you must plan ahead for preventive maintenance. Schedules must be established for periodic checks of equipment so that it can be repaired before production is interrupted.

Production workers can help

You and your staff cannot be everywhere at once. Even in emergencies, it takes your crew some time to get effective action underway. In carrying out a schedule of preventive maintenance, therefore, the production department is relied upon for assistance in two ways. First, production workers on an Automated line must be expected to make certain minor repairs and adjustments immediately. A good example would be replacing a burned out tube in a control panel without calling the maintenance men. This is something like replacing a burned out fuse and getting the house lights turned on immediately without waiting a day or two for an electrician.

The second way in which production workers must be expected to help is in spotting potential trouble spots and reporting them for correction before a breakdown occurs.

New responsibilities

The particular problems involved in keeping an Automated line operating will require higher skills, training, and knowledge on the part of your staff. Your present people must be trained to handle the complex mechanisms of Automation. Certainly, your personal responsibility will be greater.

Efficiency will be measured in

terms of downtime attributed to power service failure as opposed to production department failures. Poorly planned power services will contribute to inefficiency applied to a larger segment of total manufacturing cost in Automation. Therefore, you must be more cost conscious then ever.

Setting up a program and organizing a department to handle the complex responsibilities of sustaining Automated production may seem difficult. It is, however, a relatively simple task. We have seen power services engineers who were formerly harried with backlogs of emergency repair requests, but who became composed executives—controlling and operating a department on a planned basis, relatively free from the worry and tension of continual crises. We have seen them grow in ability and personal stature to become an important part of the Automated plant, "doctors" taking care of their "patients" before they get "sick." This is not only desirable. It is necessary. In Automation, you must run your department through planned action instead of letting the department run you.

To offset the particular problems of Automation, there will be compensations. Higher skills will command higher earnings. Assignments will be responsible ones that will be a source of great satisfaction, individually and collectively, when successfully carried out. Keeping a complete Automation line operating continuously is a challenge that only those who thrive on responsibilty will undertake and enjoy.

Automation is here. Because it is spreading very fast, you should start now to prepare and equip yourself for the challenging and rewarding positions you will hold. There are a number of ways in which this can be done. Fundamentally, you must adjust your thinking and accept the concept that Automation is here—regardless of your present habits or the lack of present acceptance of Automation by others in your plant. Progress will not be stopped. Automation is as much a part of progress as was mechanization in the First Industrial Revolution. Companies that do not recognize this inevitable trend will very likely become the "lookers" instead of the "doers."

This change in thinking need not be abrupt or upsetting. Instead, it can be just as gradual as the practical application of Automation itself. But the sooner you prepare your attitudes for the future, the better prepared you and your department will be.

What to do

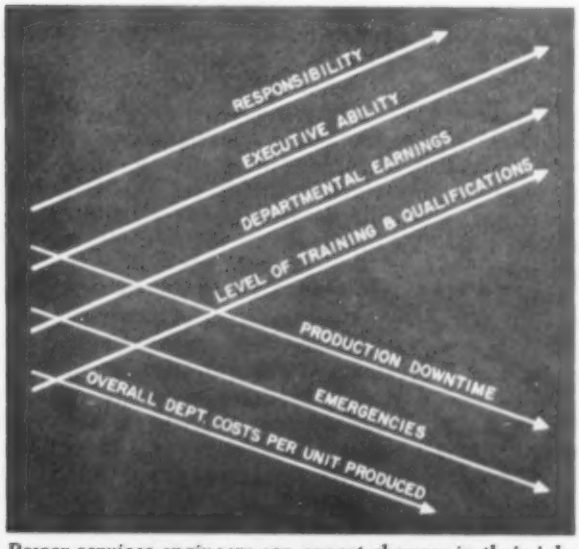
¶ First, become informed by reading. Keep up-to-date on the new ideas and equipment that will broaden your horizon.

¶ Next, begin a program of preventive maintenance, if you have not already done so. If you already have such a program, have it checked to see if it is up-to-date and efficient.

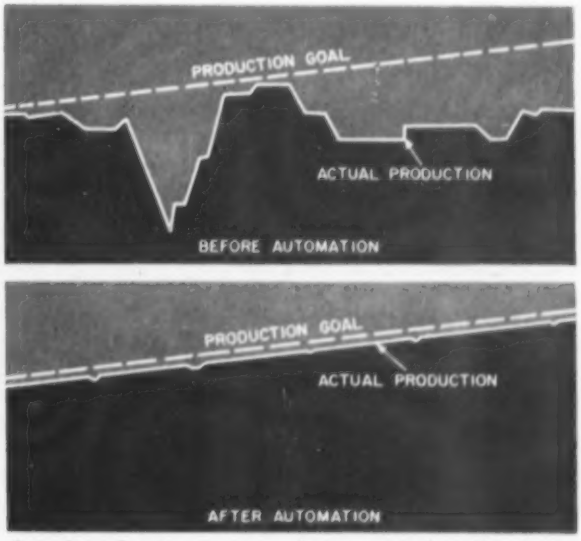
¶ Raise employment standards. When adding people to your staff, make certain that the people selected have the education, training, and experience to effectively handle the complex responsibilities of Automation. At the same time that these standards are being raised, start training your personnel—or help them train themselves—so that they will be able to adjust to the unique power services requirements of Automation.

¶ Assume leadership in schooling production workers in the ways they will be expected to help carry out preventive maintenance. (One of our engineer friends and a couple of his key men conduct five classes a week—each day they call in a different department for sessions on Automation.)

¶ Finally, set up your operations on a programmed basis—a short-range one and a long-range one. Too much stress cannot be put on the importance of planning ahead. Planning ahead today will be the best insurance for your success and your department's success in the era of Automation.



Power services engineers can expect changes in their jobs as shown above when Automation comes into their plants.



Actual production more nearly meets goals under Automation — so continuity of power services must be high.

TABLE 1
STANDARD RATINGS FOR A-C GENERAL-PURPOSE CONTROLLERS

Size of Controllers	8-hour open rating amperes	HORSEPOWER AT 110 volts three-phase	115 volts single-phase	220 volts three-phase	230 volts single-phase	440 and 550 volts three-phase	440 and 550 volts single-phase
00	10	¾	½	1	¾	1	
0	15	1½	1	2	1½	3	2
1	25	3	1½	5	3	7½	5
2	50	7½	3	15	7½	25	10
3	100	15	7½	30	15	50	25
4	150	25		50		100	
5	300			100		200	
6	600			200		400	
7	900			300		600	
8	1350			450		900	
9	2500			800		1600	

Once you've selected the motor . . . .

Consider general purpose controls

I&P EXCLUSIVE

G. W. HEUMANN
Industry Control Department
General Electric Company

Mr. Heumann was born in Germany, and graduated with a master's degree in electrical engineering from Technical University in Dresden. He has worked for Siemens-Schuckert on industrial application engineering problems, and for Westinghouse on power transmission problems. He joined General Electric in 1931 in the industrial control engineering department, organized circuit development group, became administrative assistant, engineering consultant, and is now consulting engineer, industry control department. He is author of the authoritative book "Magnetic Control of Industrial Motors".

GENERAL-PURPOSE motor controllers are intended for use with general-purpose motors driving miscellaneous machines in industrial plants. Such motors have well-defined electrical and mechanical characteristics as set forth by nationally recognized standards. Once motors are chosen to meet the mechanical drive and technological process requirements, the motor controls are selected.

Effect of power system

Most present-day industrial plants are connected to 60-cps a-c power systems. Occasionally frequencies of 25, 40, or 50 cycles are encountered. Generally, frequency need not be considered in the selection of manual controllers. However, when magnetic controllers are purchased, it is important to state the correct frequency in order to obtain proper operating coils.

Standard polyphase motor voltages are 440, 220, and 110 volts. Standard a-c control voltages are also 440, 220, and 110 volts. Since magnetic control may be used with control transformers, standard controllers are designed to operate successfully over a range of 85 to 110 percent of rated voltage. For trouble-free motor and control performance, it is important that the actual voltage at the point of motor installation falls within permissible tolerances. Otherwise, the actual motor operating voltage should be specified so that the manufacturer may allow for it in controller design (by using special coils, for instance).

Tolerance same for dc

Corresponding standard d-c utilization voltages are 230 and 115 volts. Voltage tolerances for d-c motor performance are the same as for a-c motors. It should be noted that d-c controllers cannot be used for a-c motors because the solid operating and blowout magnets would overheat. A-c controllers are sometimes used on small d-c motors.

Controller rating is determined

TABLE 2

STANDARD RATINGS FOR D-C GENERAL-PURPOSE CONTROLLERS

Size of Controllers	8-hour open rating, amperes	HORSEPOWER AT 115 volts	230 volts	550 volts
1	25	3	5	
2	50	5	10	20
3	100	10	25	50
4	150	20	40	75
5	300	40	75	150
6	600	75	150	300
7	900	110	225	450
8	1350	175	350	700
9	2500	300	600	1200

by its ability to carry rated current without exceeding temperature rises as set forth in recognized AIEE, U/L, and NEMA standards. Since most controllers are used with motors, and since rated currents of general-purpose motors are quite uniform for given horsepower and speed ratings, it has become accepted industrial practice to rate controllers in terms of standard horsepower. These ratings are based on the use of general-purpose motors that are rated on a 40 C temperature rise basis, and which have a service factor of 115 percent. This means the motors are capable of delivering 115 percent of their rated output without undue overheating, although with a higher temperature rise than 40 C.

Controllers are so rated that they are capable of carrying 115 percent of the current corresponding to the horsepower rating continuously, without exceeding permissible temperature rise. Control manufacturers base their ratings on motor current tables contained in the National Electrical Code.

Make, break max overload

In addition to carrying motor load current, controllers must be capable of making and breaking the maximum overload current that a motor may draw. In the case of a-c motors, the maximum starting and overload current is the locked-rotor current of a squirrel cage motor (generally taken to be six times rated motor current). Therefore, Underwriters' Laboratories, Inc. test listed controllers with six times rated motor current. Good contact life can be expected under these conditions. In an emergency, a-c controllers are capable of interrupting ten times their rated motor current under fault conditions.

D-c motors, except for ratings under 1½ hp at 115 volts and 2 hp at 230 volts, are started with resistance in series to reduce starting current to a value that can be commutated. D-c controllers are capable of interrupting four times their rated motor current. Standard NEMA ratings for controllers for use with general-purpose a-c and d-c motors are listed in Tables 1 and 2.

Overload protection

Under the rules of the National Electrical Code, all controllers must include means for protecting motors against overloading. The excessive current of overload causes the motor to overheat. In an extreme case, the motor may burn out and constitute a fire hazard. Hence, overload protection is an important safety factor.

Causes of overloading

Common causes for motor overloading are:

¶ Low power system voltage, which causes increased current to flow for a given horsepower load.

¶ Excessive mechanical load, which causes increased running current, or which may prevent the motor from starting — thus causing starting current to flow for a prolonged period of time.

¶ Single-phasing, which raises the running current of three-phase motors for a given load by a ratio of 1.73 to 1.

Overloading shortens life

Even if the motor does not burn out, the increased heating due to overload current reduces the life of the insulation, and hence the useful life of the motor. Motor heating is not only a function of the magnitude of the overload, but also a function of the time during which the motor carries the overload. To obtain maximum service from the motor, the overload protection should permit the motor to carry an overload for a period of time commensurate with its heating characteristic, but the motor should be disconnected as soon as enough

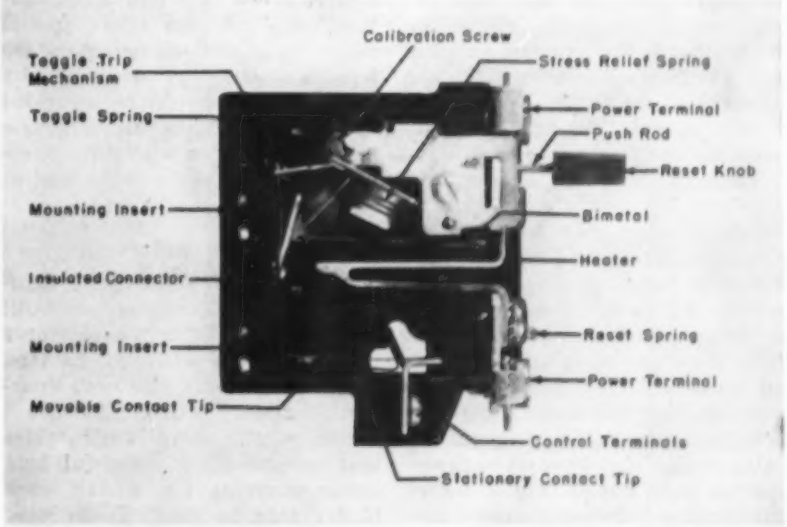


Fig. 1—Bimetal element relay is one type of thermal overload device commonly used. The other type widely used is the solder-film overload relay.

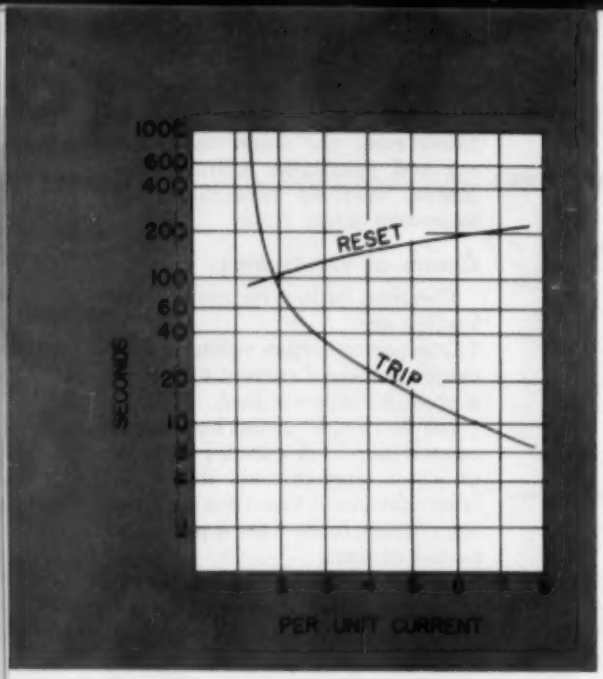


TABLE 3

CONVERSION FACTORS FOR SELECTING OVERLOAD RELAY HEATERS

Motor rating basis	*Select heater from heater table for motor full-load current multiplied by*
40C rise, continuous	1.0
50C rise, continuous	0.9
50C rise, 1 hour	0.8
50C rise, 30 minutes	0.75
50C rise, 15 minutes	0.7

Fig. 2 (left)—Typical tripping and resetting characteristic of overload relay using a bimetal strip as the sensing element.

time has elapsed to cause overheating. In designing overload protection, complete stalling (when locked-rotor current is drawn), should be considered as the maximum operating overload.

Thermal overload relays are the most commonly used type of overload protection for general-purpose controllers. Such relays consist of a temperature-sensitive element that is exposed to heat from the motor load current flowing through a resistive element. The relays are so designed that the heat transferred to the temperature-sensitive element is a replica of the heat generated in the motor. The tripping characteristic of the relay is so designed that it closely follows the motor heating characteristic. The relay is then set to disconnect the motor from the line just before the motor reaches its maximum permissible temperature.

Depending on the temperature-sensitive element, two types of overload relays are in common use. One type, the bimetal relay, is illustrated in Fig. 1. The heater causes a strip of bimetal to bend which, at a given temperature, releases a latch that trips open a spring-loaded contact. After a period of time sufficient to let the bimetal cool and return to its original position, the relay contact may be reset by pressing the reset button. Fig. 2 shows the tripping and reset characteristic of such a relay.

The other commonly used type is the solder-film overload relay. A spring-loaded spindle is held in place by a film of solder that melts suddenly when its temperature reaches a certain value. The spindle is released and opens the relay contact. After sufficient time to permit the solder to solidify, the relay contact may be reset. Tripping and resetting characteristics are similar to those of bimetal relays.

One relay in one ungrounded line suffices to protect single-phase and d-c motors. Standard three-phase motor controllers contain two overload relays, which are adequate to protect the motor in most cases. Even on single-phasing, overload current flows in at least one phase that has a relay in it. In special cases, especially when motors are fed from delta-wye or wye-delta connected transformers, overload current may show only in one phase. Controllers with three overload relays may have to be used in such cases.

Heaters match motors

For reasons of economy in manufacture, overload relays are built in quantity. Each manufacturer produces a line of relay heaters, selected to match the relay to a particular motor rating. Manufacturers publish relay heater tables that indicate the range of full-load motor currents for which each heater may be used. These relay heater tables are generally based on the use of 40 C rise motors. Heaters may be selected from such tables for motors rated on a different basis by using the conversion factors given in Table C.

Short-circuit protection

Each motor branch circuit must be protected against damage due to system faults and short circuits. Since short-circuit currents greatly exceed the interrupting ability of standard controllers, circuit breakers or fuses are used to interrupt such faults. The magnitude of the short-circuit current that may flow in a motor branch circuit is determined by the system characteristics. Short-circuit protection must be selected so that the interrupting rating is as large or larger than the "available short-circuit current" at the point of controller installation. This amount of short-circuit current is determined (by the power services engineer or by the power company) from a system study made in accordance with methods developed by AIEE.

It is customary to express interrupting rating of low-voltage circuit breakers and fuses as "total" amperes. "Total amperes," on the basis of numerous system studies, has been standardized as 1.25 times the calculated "symmetrical" short-circuit current in order to allow for the effect of the d-c component that appears in the actual short-circuit current flow.

Control manufacturers offer "combination" controllers, which

include short-circuit protective means, thereby offering controllers that protect both the motor and its branch circuit. The National Electrical Code has established rules for the selection of current ratings of circuit breakers and fuses. These rules are reflected in manufacturers' standard listings.

Let-through currents

To protect overload relay heaters against fusing and causing short circuits inside the controller, the current rating of fuses and circuit breaker trips must not be greater than four times motor rated current. A properly designed combination controller has sufficient thermal capacity so that the "let-through" current flowing prior to short-circuit current interruption will cause no harm.

Fig. 3 shows a combination starter having a molded case circuit breaker with time-delay trips. Such breakers are available in frame sizes of 100, 225, and 600 amperes. For each frame size, there are a number of trip current ratings — the smallest being 15 amperes. Interrupting ratings range between 15,000 and 40,000 amperes.

Fig. 3 also shows a combination starter employing a fused motor circuit switch. Although standard NEC fuses have no stated interrupting ratings, experience has shown that nonrenewable NEC fuses provide satisfactory protection on systems having an available short-circuit current up to 25,000 amperes. Special high-interrupting capacity fuses have appeared on the market recently, and fused combination controllers can now be obtained with interrupting ratings of 50,000 amperes.

Manual vs magnetic controllers

Manual controllers have the advantage of simplicity and low cost. They perform adequately when the motor is started and stopped infrequently. When a motor is started and stopped more than ten times an hour, however, the reduced physical effort as well as reduced maintenance of wearing parts make the magnetic controllers economically attractive.

An added advantage of magnetic control is its greater flexibility. A pushbutton can always be mounted in a location convenient to the operator, whereas space for a manual controller may not be available in the most convenient spot. Remote control from several locations, by pushbuttons or by automatically actuated pilot devices, can be easily accomplished with magnetic control. Also, several drives may be interlocked or sequenced and various safety devices may easily be introduced in magnetic control circuit schemes.

A very important safety feature of magnetic control is undervoltage protection. When power fails, the motor is stopped automatically. When power re-appears, the motor should not restart immediately, since an inadvertent start might endanger the operator who may be adjusting his machine. An action by the operator, such as pressing a pushbutton, is required for restarting the motor. Undervoltage protection can easily be included in magnetic control by proper circuit arrangement at no extra cost.

Another advantage of magnetic control is the fact that motor and control circuits can be divorced. On a manual controller, an insulation breakdown may apply full motor voltage (viz. 440 volts) to the handle that the operator would touch. On magnetic control, a control transformer may be used to step down the control voltage to 110 volts. Full motor voltage would not appear on a pushbutton or other manually actuated pilot device, an obvious safety advantage.

Although manual control has a field of application in which it will do an adequate job, the more expensive magnetic control should be considered in cases where its technical advantage and its lower maintenance requirements would result in superior performance.

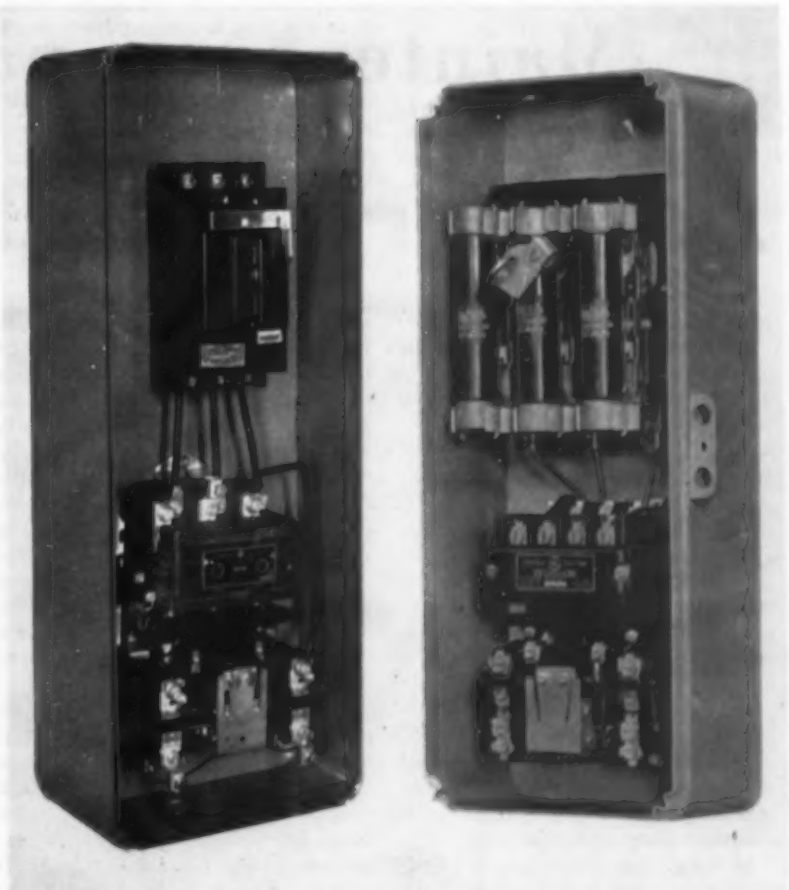


Fig. 3—Combination starters conveniently house short-circuit and overload protection. Unit on left has circuit breaker protection. Unit on right has fuses.

Fig. 1 — Brushing on the primer is best for rough surfaces, but gives an uneven film.

Get the most out of your Maintenance painting

I&P EXCLUSIVE

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MAINTENANCE PAINTING may be reduced drastically, in the face of generally rising costs, by a basic understanding of painting fundamentals[1].

One basic point should be settled at the outset: is the repainting for protection or for appearance? It may be for either or both. It may even be functional — such as for skid resistance. The philosophy determining repainting intervals will vary depending on whether maximum protection is desired, or whether good appearance is the primary factor. Good protection is possible while simultaneously maintaining good appearance. But maximum protection at minimum cost may not be compatible with optimum average appearance.

In many cases, painting for protection is unnecessary. The slight rusting that occurs on structural steel, for example, cannot be considered structurally detrimental. It is often possible to increase the original thickness of the steel by a corrosion allowance and eliminate painting completely. The unsightly appearance that usually results may well be the factor that calls for painting in this day of color consciousness. (Color conditioning is not money wasted since the increased production, better working conditions, elimination of hazards, and improved morale are positive compensations for the additional expense involved.)

To achieve minimum maintenance painting cost, push the annual painting cost per square foot of surface to a minimum through proper surface preparation, proper paint application, and proper selection of paints and coatings. High initial costs may be frightening, but the real test of painting economy is the cost per square foot divided by the years of service between repaintings. Even this analysis does not go far enough. Very high initial surface preparation costs may be depreciated over a cycle of repaintings if follow-up preventive maintenance painting is undertaken early enough to protect the original investment in surface preparation for the first painting.

Rust is the greatest enemy of paint. Rust is the greatest deterrent to long paint life. When rusting is permitted to continue, rust scale forms. Any coating — whether grease, oil, mastic, or any type of paint — soon fails as the rust scale lifts in sheets or pieces. All rust scale must be removed — by chipping or scaling hammers, vibrating or rotary scalers. After removal of rust scale, real cleaning of the surface begins.

Rust — the loose, amorphous agglomeration of hydrated iron oxides

— cannot be successfully covered. Quit kidding yourself if you think it is possible, all advertising claims to the contrary. Tightly adherent, light residues of rust, or rust staining, that remain after cleaning can be tolerated in milder environments by selection of proper pretreatment or priming paint. Chemical removal of rust has not yet proved practical for use in the field, except for removal of very minor or very light deposits. Acid cleaners of the cold phosphate type are successfully used for very light rust deposits. However, these cleaners have proved detrimental, or at best ineffective, in removing heavy rust. The best use of these cold phosphate materials is on descaled, essentially rust-free steel.

Rust removal methods

Rust is removed by hand, power, flame, or blast cleaning. Hand cleaning is probably the most extensively used, but the least effective and often the most costly method. Hand chipping hammers, scrapers, wire brushes, and abrasive paper are used to clean off loose old paint and rust. Any old mill-scale that has lifted is removed at the same time.

There should be a clearcut decision on the problem of old paint. Where painting is primarily for protection, there is little advantage to removing sound, tightly adhering paint. When this paint becomes "dead" and poor adhesion develops, then remove it. Otherwise, it should be allowed to remain, since *the protection afforded is proportional to the thickness of the paint.* Where paint is thick and comes off in patches, the edges of the remaining old paint should be feathered to help smooth the surface for better appearance.

Cleaning small areas

Hand cleaning may be economical where the amount of area to be cleaned is small, or where the cost of setting up power tools or better cleaning methods is out of proportion to the amount of work involved. For small areas, hand cleaning may be effective enough to permit use of poor wetting, synthetic types of paint.

For large areas, the amount of labor involved is too great. Power tools or other mechanical methods of cleaning provide a better surface for painting than hand cleaning. Surprisingly, the cost per square foot for power tool cleaning is about the same as for hand cleaning. But the degree of cleaning is much better when power tools are used. Obviously, the amount of work accomplished per manhour is much greater when power tools are used. When a man uses a blast cleaning setup, he can utilize 10, 20, or 50 hp of energy. In view of the high ratio of labor costs to total painting costs, it is important that the greatest practical use of power tools and mechanical devices be made wherever possible.

Abrasive discs and grinding wheels used on power wire brushing or sanding machines remove 100 percent of rust and scale, but such methods are usually prohibitively expensive and impractical except for very small areas. Vibrating scalers or rotary scalers are quite effective on surfaces that have been neglected and are in an advanced state of rusting.

Use tools with care

Caution must be exercised when using mechanical tools. Sharp burrs and ridges must not be left on the surface. Such peaks and sharp edges are difficult to cover adequately. They result, almost invariably, in premature rusting which leads to undercutting and failure of the whole system. Excessive power wire brushing causes burnishing and poor paint adhesion. This is a case of too much work resulting in harm. Excessive blast cleaning, or improper flame cleaning, may also cause harm.

Where safe, flame cleaning may be utilized to prepare old surfaces for repainting. The technique depends on the condition of the surface. One or more passes of the flame may be necessary to remove thick layers of old paint or heavy deposits of scale and rust. Wire brushing — and sometimes scraping — must follow flame cleaning. Removal of loose debris and dirt, and priming *while the steel is still warm* are necessary to obtain maximum advantage from flame cleaning. If not done, much of the value of this comparatively expensive cleaning method, may be lost, and the final paint job will suffer.

Blast cleaning is the best method of surface preparation for general repainting work. It is expensive. Often it is not feasible because the debris and dust may cause harm to adjacent machinery.

Three grades of blast cleaning

Fig. 2 — Inaccessibility of corner rules out most cleaning methods except blast cleaning for proper, economical surface preparation prior to painting.

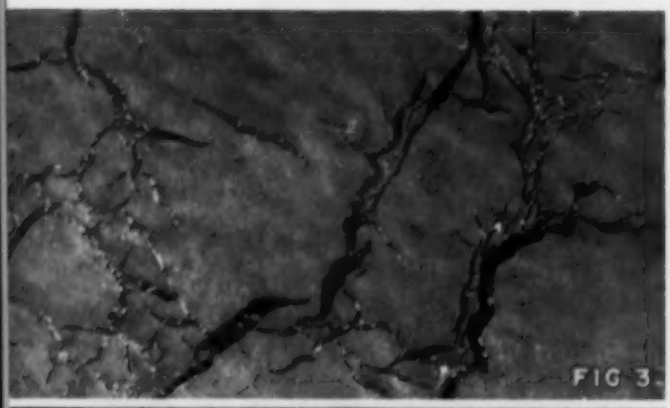

Fig. 3 — Alligatoring of coating over incompatible primer.
Fig. 4—Corrosion in damp corner where debris collects.

Fig. 5—Flaking old paint requires complete removal.
Fig. 6—Failure by blistering because paint was too thin.

preparation are usually recognized:

¶ Blast cleaning to white metal (in which all traces of rust, paint, mill-scale, and residue are removed).

¶ Commercial blast cleaning (which is done at a rate that cleans the surface satisfactorily for most operations but which may leave slight residues of rust, mill-scale and old paint).

¶ Brush-off blast cleaning in less severe exposures (which is a very quick brushing of the surface by the abrasive stream to remove most of the rust and to cut up the mill-scale and old paint sufficiently to provide a good base for paint).

Sand blasting is generally used in the field. Where the abrasive can be recovered, synthetic abrasives, crushed iron shot, or grit may be used. Proper selection of abrasives is of paramount importance in providing a proper surface anchor for paint and in securing economical cleaning. If the surface is too rough, rapid failure of the paint will generally follow. Blast cleaning removes old paint and rust, and leaves the surface in best condition for repainting.

Solvent surface cleaning

Solvent cleaning is often the first step in repainting. If the surface has not been allowed to rust, then solvent cleaning may be all that is necessary to remove oil, grease, soil, salt deposits, and the host of other contaminants that must be removed for maximum paint life. Corrosion accelerating agents, such as salt deposits, are particularly detrimental and should be removed before applying further paint. Oil and grease are particularly harmful to paint adhesion. If they are not removed, the paint may peel off in layers. Chalked paint may be removed by solvent cleaning. If this is the only type of contamination on the surface, however, it may be tolerated by paints with fairly good wetting properties.

Cleaning by solvents may take the form of washing with mineral spirits or other safe solvents (never use benzene or gasoline), or with water for water soluble materials. A solution of soap, detergent, or mild alkali is often used for preparing old painted surfaces. Vapor degreasing, alkaline immersion, and similar methods are useful for small items that can be handled in tanks. Spraying alkaline cleaning solutions over large areas is feasible, but should be followed by a thorough rinse to remove residues of alkali. Solvent cleaning may be carried one step further — to complete stripping or paint removal by the use of powerful solvents or very strong alkaline solutions.

For large structures, spraying of hot paint stripping solutions works well. Thickened paint removers may be applied and later flushed off with hot water or steam. Such paint removal approaches blast cleaning in cost, and should be used

for surfaces where blast cleaning is impossible. Paint strippers generally require further surface preparation and cleaning after the removal of the old paint.

Pretreating the surfaces

Pretreatment of the surface sometimes improves performance of the paint. Wetting oil pretreatments — with drying oils such as linseed oil — are beneficial on cracked and broken mill-scale. They are good for surfaces with rust residues that cannot be better cleaned for practical or economical reasons. By saturating the surface, they help prevent stripping of the oil vehicle from the paints. They also improve bonding and adhesion of quick-drying paints, which generally have poor wetting for such surfaces. The wetting oil pretreatment must be compatible with the priming paint applied.

Severe exposure treatment

Cold phosphate pretreatment of blast-cleaned steel improves the performance of paints in severe exposures. Its use does not appear to be warranted for normal exposures except as a rust preventive to eliminate corrosion for short periods prior to priming. Cold phosphate conversion processes are available for treatment of blast-cleaned steel. These are particularly effective on galvanized metal and aluminum. They may be brush applied or spray applied.

Hot phosphate surface conversion processes are desirable for articles small enough to treat by immersion or in spray washers. Wash primer pretreatment is extremely effective on rust and scale-free steel. It is practical for large structures. Its use is warranted for very severe exposures, but its economy is questionable in mild exposure. In some cases, the wash primer pretreatment is essential to ensure adhesion of some vinyl paints to bare steel. Wash primer pretreatment on steel surface bearing rust residues is generally much less effective. Correct application is critical.

Cleaning costs may vary greatly, depending upon local conditions such as accessibility, amount of staging required, local regulations, and safety requirements. When the repainting has been deferred beyond the proper time, cleaning costs may represent one-quarter to one-half of the total repainting cost. To keep surface preparation costs to a minimum, repainting in time is expedient.

TABLE I

Degree of Rusting or Area Exposed	*Cleaning and Painting Recommended*
No rusting	Solvent clean if necessary. Apply one or two coats of finish paint, depending upon conditions.
Slight rusting in localized areas	Spot clean and spot prime. Apply one or two overall coats of finish paint as necessary.
25% to 50% rusting in localized areas	Spot clean and spot prime. Apply one overall coat of priming paint, and one or two coats of finish paint as necessary.
Over 50% rusting	Remove as much old paint as is practical. Apply two priming coats and one finish coat, or one priming coat and two finish coats as necessary.
Where there is large area of sound adhering paint, which is not too thick to be detrimental	Spot clean bad areas. Apply enough coats of rust inhibitive primer over these areas to build them up to a satisfactory level, then one or two overall finish coats.

The correct time for repainting can be determined only by local experience and inspection. Inspection should be done at sufficiently frequent intervals to catch the system before breakdown has progressed too far. It is impossible to set down general rules to govern the repainting time intervals. Table 1 is a summation of current practice.

If all coats of a painting system are of different colors, then the topcoats wearing away will expose the underlying coats. When the intermediate coat shows, it is a sure indication that it is time to repaint. At that time, surface preparation costs may be zero, or a nominal cost for solvent cleaning or washing. One or two overall coats of finish paint (usually cheaper than priming coats) are then applied to build up the system to full effectiveness.

By using chalking paints, exterior finish coats wear away gradually, and old paint does not build up excessively. Excessive build up of old paint should be avoided since it leads to failure by cracking. Once cracking of paint occurs, it leads to flaking of the entire system, exposure of the metal to corrosion, and requires complete removal of the old paint by costly surface preparation. For the same reasons, painting primarily for appearance should employ thin-film paints and a minimum number of coats at each

Fig. 7 — Hand chipping and wire brushing are often necessary but slow, costly methods of preparing badly neglected surfaces. Timely repainting pays off.

repainting to avoid excess build up.

Paints have a tremendous variation in hiding power. Standard hiding power tests should be carried out to evaluate the efficiency of paints in covering up. Sometimes one coat of good paint may replace two coats of poor hiding power.

Good application essential

Good paint application is essential for long paint life. Good application includes storage of paint, thinning and mixing, temperature and humidity requirements, drying, and handling of the work.

Brushing of the primer is believed to be best for rusty, dirty, or rough surfaces that must be painted in that condition. Proper spray painting, however, will achieve good results. Either spray painting or brushing of intermediate and finish coats is satisfactory, but a better looking job is generally achieved by spraying. Brushing has a tendency to result in uneven films, with subsequent breakdown and corrosion occurring in the valleys of the brushmarks.

Get maximum thickness

When painting is done for protection, maximum film thickness per coat of paint should be the goal of the painter, rather than maximum coverage per gallon. Obviously, excessive paint film thickness should be avoided since it leads to improper drying, wrinkling, checking, or alligatoring. In this connection, brush-applied coats of synthetic varnish paints tend to be thicker than spray-applied coats due to the excessive work required by the painter in brushing out such high-viscosity paints. Oil paints, which brush easily, tend to have a greater thickness when sprayed.

Paint film thickness should not be a hit-or-miss proposition. It should not be left to the judgment of the painter. Wet film thickness gauges are available to indicate the thickness of the wet film being applied. By correcting for the nonvolatile content of the paint, the dry film thickness can be calculated instantly at the time of application.

Dry film thickness meters are available in a number of types. These are used as a check on the actual thickness of paint after drying. They must be used with caution and with knowledge of their functioning, since erratic and misleading results may be obtained on rough surfaces, mill-scale, rust, and old paint.

Primers should be applied at 1½ to 2 mils dry film thickness for conventional paints. Subsequent coats of paint should be applied at 1 to 1½ mils thickness. The goal of the maintenance painter should be to have a minimum of five mils dry film thickness of paint applied in three coats for proper protection in industrial or equally severe environments. When painting is solely for decorative purposes, paint film thickness should be kept to a minimum to avoid excess build up.

Requirements for good job

The requirements for good painting are well known. New, detailed specifications are available[2]. They include dry and clean surfaces; temperature of the surroundings 40 F or above; temperature of the surface above the dew point of the air; relative humidity of the air below 85 percent. Painting should not be started when rain or snow is imminent, nor should fresh paints be allowed to freeze.

Paints should not be thinned beyond the point necessary for good application. Viscosity of the paint for correct application should be known and measured with one of the low-cost, easily used, portable types of viscosimeters. Generally, the directions of the paint manufacturer are good and should be followed. Great caution should be exercised in the case of paints offered as panaceas. Obviously, painting outdoors should be undertaken during good weather.

Spraying cuts costs

Considerable savings in application costs are possible through the use of spray equipment, but the technique should be thoroughly mastered. Misuse of spray equipment by supposedly capable painters is astounding. Application by use of rollers promises to be economical, and is often feasible when spray painting is not. Special long nap, large diameter rollers have been used with marked success on difficult-to-paint jobs such as fences. (Floor push brooms have also been used). For flat surfaces, the normal types of paint roller are satisfactory, but require brush work on welds, rivets, and edges.

Flow coating by use of properly formulated paints results in considerable savings. Paint is pumped through a hose and flowed over the surface; the excess paint runs off the article being painted, is collected in a trough or sump, and is recirculated. For smaller components, dipping is economical.

Paint is usually too thin on sharp edges, rivets, welds, crevices, interstices, and projections, even though it is of adequate thickness on the plane surfaces. To guard against premature breakdown and spoiling of the paint job, such edges should be stripe painted — an extra coat of paint applied to these critical spots. This paint should be the same as the primer but should generally be of a contrasting shade. The primer may be tinted with carbon-black for contrast.

The striped coat of paint is applied after cleaning and allowed to dry. An overall coat of primer is then applied. If this procedure results in leaving large areas of the surface bare of paint and subject to corrosion, then the overall coat of primer may be applied first and a contrasting striping applied after the primer has dried.

Spot painting

Spot cleaning and spot priming in maintenance painting often may be just as effective as complete cleaning and painting, and may result in considerable economy. In such cases, the areas actually rusting or broken down are cleaned and spot primed. The question then arises whether to spot coat, or to apply overall coats of paint.

Generally speaking, this question is related to the desirability of maintaining paint systems by scheduled inspection and repair procedures. The life of the coating is prolonged through preventive maintenance, which includes spot cleaning and spot painting when necessary. If deterioration is not permitted to go too far, spot repainting will blend into the surrounding paint after a short period of exposure. Such painting is economical and helps prevent build up of excessive paint thickness.

(Continued on page 66)

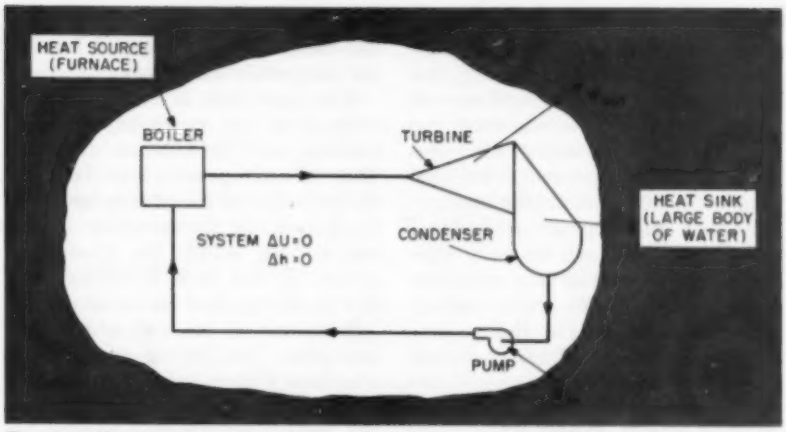

Fig. 1—Continuous conversion of heat into work without losses by a cycle.

A Thermodynamics Refresher—III

Steam power cycle relationships

Review thermodynamics with the help of this easy-to-read series. It carries on from last month's basic concepts to discuss steam power cycle processes and the relationship of the cycle to source and sink.

I&P EXCLUSIVE

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THE POWER CYCLE, which is the instrument for the continuous conversion of heat into work, rests squarely on applications of the First and Second Laws of Thermodynamics. The First Law states that energy may be neither created nor destroyed. The Second Law states that no system can receive heat at a given temperature and reject it at a higher temperature without receiving work from the surroundings. These Laws are always exacting, and often can be very subtle.

It follows from the First Law that if a process is to directly convert heat into work, or vice versa, there must be no net change in the internal energy of the system.

Although a single process for the continuous conversion of heat into work appears to be elusive, recall that the definition of a thermodynamic cycle requires the system to be returned to its initial state. We know from our study of the Carnot cycle and from the Second Law that heat must always be rejected from a system sometime during cyclic changes of state. We can never hope to convert all the heat added in a cycle into work. However, from the First Law, it is evident that the rate of the net heat transfer into the system is always equal to the resultant work done by the system.

Since the rate (with respect to time) of producing work is called power, a cycle that provides for the continuous conversion of heat into work is known as a *power cycle*. A device that provides for a working substance to undergo a cyclic change of state in which heat is converted into work is known as a *heat engine*.

The *system* is defined as the working substance that undergoes the cyclic change. In a steam power plant, the *system is the steam*. The resultant heat transfer into the system is the heat added minus the heat rejected. Considering all Q's to be positive, the resultant heat transferred is $(Q_2 - Q_1)$. (See Fig. 1.) Similarly the resultant work done by the system, commonly called the net work, is the gross work done by the system minus any work done on the system. Then from the First Law and the definition of a cycle we have

$$Q_2 - Q_1 = W_{net} \qquad (1)$$

The efficiency of conversion of the heat added into net work is called the thermal efficiency, or

$$eff_{th} = \frac{Q_2 - Q_1}{Q_2} = \frac{W_{net}}{Q_2} \qquad (2)$$

No mention has been made yet of the Second Law. Consequently these equations are equally valid for reversible and irreversible cycles. To obtain a more meaningful appraisal of a power cycle we must search for those lost opportunities to convert heat into work as manifested by the irreversibilities within the system and in the system's interaction with other systems. To evaluate the irreversibilities, and indeed to recognize the simple fact that Q_1 is always greater than zero, the Second Law must be introduced.

The source and sink

The Second Law requires that a heat engine operate between a high-temperature source supplying the heat and a low-temperature sink receiving the rejected heat. It is clear that those temperature levels obtained within the heat engine must be intermediate between the temperatures of the source and sink. (See Fig. 1.) It is also clear that the source and sink must be capable of supplying and absorbing heat, respectively, without temperature change or they would eventually reach equilibrium, and no further heat transfer could take

place. The source and sink must have infinite heat capacities.

No truly infinite source or sink exists, but Nature provides good approximations to an infinite heat sink in the form of oceans, rivers, and the atmosphere. For sources, we have to rely on the finite sources provided by a continuous exothermic chemical reaction—such as the combustion of fuels.

It is of paramount importance that (as nearly as possible) all the energy released by the fuel appears as heat added in the cycle. The owner of a power plant pays, in effect, for the chemical energy within the fuel. He is interested in converting as much of this energy as possible into useful work. An

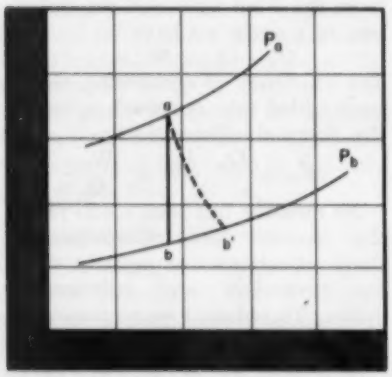

Fig. 2—Steam expansion in a single-stage turbine on a Mollier diagram.

analysis of the power cycle may explain the difference (loss) between the heat added in the heat engine and the net work done by the engine. Only an analysis of the source and cycle together, however, can adequately explain the losses attendant to the overall conversion of the chemical energy in the fuel into work.

When a suitable mixture of fuel and air is burned completely in a furnace, flame temperatures approaching the order of 3500 F may be reached. Metallurgical considerations impose a maximum of about 1150 F on the highest temperature reached in the cycle. As a result of the large temperature difference between the source (flame) and the working substance of the cycle in the heat-addition process, the heat transfer is highly irreversible. Furthermore, if all the heat is added isothermally at 1150 F, a considerable amount of the energy released in burning the fuel cannot be recovered. Some recovery can be made by preheating the combustion air, but practical considerations make 300 F about the limit.

We can see that an analysis of the power cycle can be very misleading if consideration is not given to the losses in the finite source, the irreversibilities in the source, and the irreversibilities between source and cycle.

Steam power processes

The schematic diagram (Fig. 1) shows how the basic components (boiler, furnace, turbine, condenser, and feed pump) are related in their functions of converting heat to work. Steam is generated in a boiler, which receives heat from a source existing in the form of burning fuel in a furnace. The steam leaving the boiler is saturated at a temperature determined by the operating pressure. The steam may be then superheated to 1150 F at the boiler pressure in a superheater if one is provided. The flow path of the steam and water in the boiler and superheater as well as the flow path of the gaseous combustion products are arranged to approximate counterflow heat transfer in order to minimize irreversibility.

In the turbine, steam flows through stationary nozzles at a steady rate, acquiring *kinetic* energy at the expense of a decrease in *enthalpy*. The high-velocity steam then impinges on blades fixed to the turbine rotor, with the result that the kinetic energy is converted into work. Kinetic energy essentially is the middleman in the conversion of enthalpy into work. The entire process is approximately adiabatic. It is not completely reversible, however, and hence is not isentropic.

Steam may expand in a turbine in one or more steps, called stages. Figure 2 shows, on a Mollier diagram, the expansion process for a single-stage turbine. The process is assumed to be adiabatic, and the maximum work can be obtained from a reversible adiabatic (and hence isentropic) process. This simply means that the energy available for conversion, within the meaning of the Second Law, is all converted into work.

The final state is defined by the entropy of the steam entering the turbine and the exhaust pressure. The exhaust pressure is fixed by the pressure of the atmosphere, the condenser, or the pressure in the region into which the steam exhausts. If the flow is steady, and kinetic energy and potential energy differences in the end states are negligible (a fair assumption for a turbine,) the maximum work and the available energy are equal to the isentropic enthalpy change, or

$$W = \triangle h_s = h_a - h_b \qquad (3)$$

No real process is reversible, and an isentropic expansion in a turbine must be regarded as an ideal. We know from the Second Law that the entropy must increase, but how much depends on the irreversibilities encountered in the process. However, the final state can be defined since the temperature, pressure, and quality of the steam may be found by actual measurement. Therefore, the final state can be represented by the point b' on the Mollier diagram. The actual expansion path a-b' is not known. This is immaterial since we are expressing work in terms of the change of a property, enthalpy. Accordingly the work done by the turbine for the irreversible adiabatic expansion from a to b' is

$$W = h_a - h_{b'} \qquad (4)$$

This work is known as the internal work since only the irreversibilities

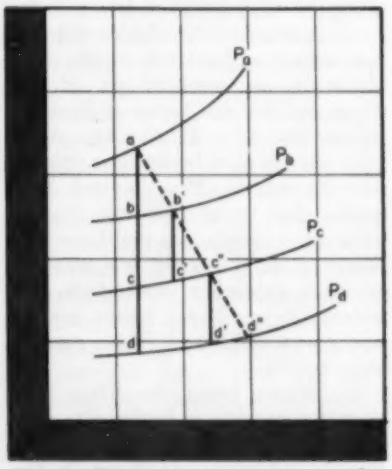

Fig. 3—Steam expansion in a multi-stage turbine on a Mollier diagram.

within the flow passages of the turbine can affect the state of the steam. External losses incurred because of bearing friction, gears, auxiliaries, and so on, can have no effect on the state of the steam. If the external losses are deducted from the internal work, the result is the brake or shaft work.

Define efficiency

We define the engine efficiency of a steam engine or turbine as the ratio of the actual work, on any basis, to the ideal work as given by Eq. (3). As an example, the internal engine efficiency for the turbine whose expansion is shown in Fig. 2 may be expressed as follows, assuming the expansion is adiabatic and changes in kinetic energy are negligible

$$\text{eff}_{\text{int}} = \frac{h_a - h_b'}{h_a - h_b} \qquad (5)$$

Similarly, the brake engine efficiency is

$$\text{eff}_{\text{br}} = \frac{W_{\text{brake}}}{h_a - h_b} \qquad (6)$$

If the turbine drives a generator, the overall or combined engine efficiency is the ratio of the work developed at the generator terminals to the ideal work, or

$$\text{eff}_{\text{comb}} = \frac{W_{\text{gen}}}{h_a - h_b} \qquad (7)$$

The external losses may be taken into account by means of the mechanical efficiency, eff_m — which is defined as the ratio of the brake work to the internal work. Accordingly the brake engine efficiency is expressed

$$\text{eff}_{\text{br}} = \frac{(h_a - h_b')\ \text{eff}_m}{h_a - h_b} \qquad (8)$$

Most turbines are comprised of more than one stage. Relationships developed for the single-stage turbine, however, are equally valid for any turbine taken as a whole.

Now we shall consider the individual stages of a multistage turbine, taking the three stages in Fig. 3 as an example. The maximum work that can be developed in the turbine (available energy) is shown by the isentropic process *a-d*. The pressures p_a and p_d are fixed by the initial state of the steam and the exhaust pressure, respectively. The pressure p_b and p_c are fixed as a result of design considerations.

The maximum work that can be done in the first stage is $(h_a - h_b)$. The actual work is $(h_a - h_b')$. However, the enthalpy difference $(h_b' - h_b)$ is made unavailable for conversion to work in the first stage because of the irreversibilities. Part of it, however, becomes available to do work in the second stage. Now the energy available to do work in the second stage is not $(h_b - h_c)$ but is $(h_b' - h_c')$, which is greater than $(h_b - h_c)$ because the slope of the constant-pressure lines increases with temperature.

Similarly, if the entire expansion is in the vapor region, $(h_c'' - h_d') > (h_c - h_d)$, then the sum of $(h_a - h_b)$, $(h_b' - h_c'')$, and $(h_c'' - h_d')$ is greater than $(h_a - h_d)$. Does this mean that the maximum work that can be done in the turbine has been increased because of the irreversibilities? Certainly this cannot be true since it would contravene the Second Law. Suppose the expansion process followed the path *a-b-b'-c'-c''-d*. The work then done is the difference of the enthalpies in the end states, or $(h_a - h_d')$. Clearly $(h_a - h_d)$ is greater than $(h_a - h_d')$.

A closer scrutiny of Fig. 3 reveals that the sum of the energies available in the stages is greater than the energy available for the entire turbine simply because the energy made unavailable in each stage, because of irreversibilities, becomes part of the energy available in the succeeding stage.

The locus of the end states of the stage expansion, or *a-b'-c''-d''*, is called the *condition line* of the steam expansion in the turbine. The stage efficiency, which is actually the engine efficiency of the stage, is defined as the ratio of the actual work done in a stage to the ideal work of that stage. Now the sum of the actual work done in the stages must equal the internal work done in the turbine. Assuming a uniform value for the stage efficiency eff_s,

$$W = \text{eff}_s\,(h_a - h_b + h_b' - h_c' + h_c'' - h_d') = \text{eff}_{\text{int}}\,(h_a - h_d)$$

whence

$$\frac{\text{eff}_{\text{int}}}{\text{eff}_s} = \frac{h_a - h_b + h_b' - h_c' + h_c'' - h_d'}{h_a - h_d} > 1 \qquad (9)$$

since the sum of the energies available in the stages is greater than the energy available to the turbine. This expression is commonly called the reheat factor.

Next Month: Another article in INDUSTRY & POWER'S *Thermodynamics Refresher. Prof. Lee will discuss "From Carnot to Rankine."*

Weather can hurt your boiler

BAD WEATHER can result in damage to boilers in more ways than may be realized. It cannot destroy a boiler shell by direct action, but it can directly damage a less sturdy though vital part, such as a control, an auxiliary, or an unprotected section of piping . . . .

Wind and lightning either combined or separately can cause boiler furnace explosions in many ways. They set up surges or cause outages to power lines and these conditions may then be reflected in the operation of motor-driven boiler auxiliaries. No one can predict which of the motors will be stopped or which will not be affected. For instance, the failure or erratic operation of motors driving draft fans may not be accompanied by a similar condition as respects the motors driving fuel pumps . . . .

Increasing numbers of boilers are being installed outside or under semi-outdoor conditions, the theory being that the water cannot freeze in the boilers while they are being fired. However, water in attachments can freeze, and it can do so in a manner which will deceive operators and prevent controls and safety devices from working. . . . Freezing of accumulated moisture in pneumatic controls and of water in siphons for pressure gages also has caused serious trouble. Ice in chambers of low water cut-outs often has held floats in the upper positions. Normally warm climates have not spared outside installations from accidents caused by freezing . . . .

—W. H. Russell, engineer, *The Locomotive* of the Hartford Steam Boiler Inspection and Insurance Company.

In brief . . . .

Industrial waste conference

PROCEEDINGS of the Ninth Industrial Waste Conference held at Purdue University have been released. Sponsors of the Conference were the School of Civil Engineering and Division of Sanitary Engineering, Purdue University and the Division of Sanitary Engineering, Indiana State Board of Health. Among other groups giving support and assistance were the American Water Works Association and the Industrial Wastes Association. Though the sponsorship of this Conference was primarily by Indiana groups, the proceedings have merit for the entire country.

Wastes treatment—Fairless Works

G. A. Howell, assistant to chief engineer, steel
United States Steel Corporation

"The variety of products produced at the Fairless Works results in a variety of industrial wastes. Primarily, these wastes include acids, alkaline solutions, oils, both soluble and insoluble, settleable solids and other miscellaneous wastes . . . . Plant engineers designed and installed treatment facilities which, it is believed, are unique in the steel industry.

"Where possible, waste waters containing mill scale, acids, flue dust, and concentrations of oils and greases are treated at their source to such a degree that the effluent may be discharged directly to the river or to a separate treatment plant near the river, if required. This terminal treatment plant services all process non-acid waste waters. This effluent from the terminal treatment plant is of such a quality that it may be discharged directly into the stream or recirculated through the plant system.

"The design of the treatment facilities at the Fairless Works was based on these underlying principles: First, segregation of the wastes as to their essential characteristics; and second, the combination of wastes so as to combine them most effectively in the treatment processes. Thus, for example, oil and acid wastes are concentrated in one area for treatment: namely, the oil interception plant."

Biochemical oxygen demand in a treated industrial effluent

Summer Kaufman, sanitary chemist
Lederle Laboratories Division
American Cyanamid Company

"A list of chemical constituents making up the organic fraction of a specific industrial waste is without limit. Included are (a) substances which can be easily oxidized biochemically such as straight chain alcohols, sugars, aldehydes and ketones; (b) those more complex molecules which may be decomposed in part leaving a residual of stable products; and (c) that group of substances which defies biochemical breakdown under conditions that exist under normal sewage treatment plant operation. . . .

"The part played by temperature in biological metabolism is well known. An active biota will result in a more complete utilization of organic matter than one whose metabolism, which because of low temperatures, is substantially reduced. One result of reduced metabolism is incomplete oxidation, thereby affecting degree of treatment and hence the B.O.D./O.C.D. relationship.

"The filter biota and substances which regulate its growth play an important role in the biochemical breakdown of organic solids. The presence of an antibiotic or other toxic substance may, by inhibiting a certain group of microorganisms, prevent the buildup of the complex system of biological life necessary for ultimate decomposition. The resulting unbalanced biological system, incapable of utilizing completely the food at hand will allow this material to pass unconverted through the process with a resulting poor B.O.D. reduction.

Plating wastes—a review of research

D. Gardner Foulke, manager
Electro-Chemical Development

Raymond F. Ledford, engineer
Industrial Filter and Pump Company

"The trends in waste elimination point up (1) the advantages of good housekeeping and engineering practices and (2) the growing importance of water conservation in the industrial economy.

"The reduction of the quantity of wastes has been effected by the use of reclaim rinses (a still rinse following the plating operation), the elevation of conveyor arms for a number of stations at the end of the plating tank to permit drippage into the plating tank, the use of ion exchange systems and other purification means to eliminate the need for periodic dumping (anodizing and pickling) and, finally, by enlisting the aid of the design engineer to provide drainage of the part and minimize dragout.

"The conservation of water has been accomplished by the use of spray or fog rinses, the use of ion-exchange or chemical treatment (e.g. cyanide destruction) in conjunction with rinses, the injection of air into rinses to make for better rinsing with less water, and the use of valve locking devices to limit the amount of rinse water to as much as shown by study to be sufficient."

Chlorine gas feeders in industrial waste treatment

R. W. Pearce
Builders-Providence, Inc.

"The efficacy of chlorination as a waste treatment process depends on the inherent chemical activity of chlorine. Chlorine is a strong oxidizing agent and a powerful bactericide. It is also an active ele-

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Industrial waste conference

. . . starts on page 62

ment which will combine with many chemicals both inorganic and organic to form stable compounds which have little or no nuisance characteristics when discharged into receiving bodies of water.

"If the waste contains compounds such as sulfides, cyanides, mercaptans or other chemical compounds in a reduced state, chlorine will oxidize and stabilize the waste. This action of chlorine is utilized in the treatment of phenols, cyanides, coke and gas wastes, plastic wastes, etc."

Water quality criteria

W. W. Towne

John W. Wiseman

Ohio-Tennessee Drainage Basins Public Health Service, Ohio

"Every one has listened to discussions and read papers in which the words 'standards,' 'criteria,' and 'objectives' have been used extensively in defining a water quality. In many instances they have been used synonymously, particularly 'standard' and 'criteria.' Probably because the word 'standard' may smack of regulation, there has been a tendency on the part of some to differentiate between the meaning and usage of these words. . . .

"What purpose do water quality criteria serve? . . . Consider for a moment the various doctrines of water use. Probably the oldest is the common law doctrine of riparian rights, wherein each riparian owner is entitled to use the water passing through or by his property . . . . but is required to pass it on to the next downstream owner, essentially undiminished in quantity and unimpaired in quality. . . .

"Another doctrine of water use, prevalent throughout the western states, is the doctrine of prior appropriation. Under this concept, the first in time is the first in right. That right is retained so long as beneficial use is made of the water. All other water uses are secondary to the appropriated use. It is interesting to note that this doctrine is being advocated in some of the eastern states for the apparent purpose of establishing a priority for a particular water use.

"Some of these uses [of public waters] are in conflict with others, and where the water resources are inadequate to supply the needs of all, there must be a compromise based upon the public's interest.

"It would appear that the principal purpose of water quality criteria is to serve as a tool for carrying out a reasonable pollution abatement plan geared to safeguarding the many water uses which are in the public's interest."

Some geological factors in underground waste disposal

Norman F. Billings, chief, hydrology division

Michigan Water Resources Commission

"Geology has much the same importance with regard to putting liquids into the ground as it does in taking liquids out of the ground. In fact, waste injection is probably even more acutely dependent on geological conditions than is the production of oil or water, because it is so closely tied into plant location. Advantage must be taken of conditions within the immediate vicinity of waste production as contrasted with the feasibility of going far afield in search of favorable oil or water production sites.

"Underground geology is seldom easily appraised because it is hidden from view and because the processes which were involved in the creation of most geological sections were highly complicated. . . .

"The first step in determining local prospects for underground waste disposal is to examine all available records of deep well drilling in the vicinity. Such records may generally be found in the office of the state geologist, and his assistance in their interpretation will be very desirable. If promising strata are shown, the propriety of using them should be determined before further steps are taken. That determination should include obtaining whatever government permission is necessary as well as investigation of other local uses being made of the formation, such as oil or gas or brine production."

Some revised concepts concerning biological treatment

Clair N. Sawyer
Massachusetts Institute of Technology

John D. Frame
Metcalf & Eddy

John P. Weld
United States Public Health Service

"There is widespread belief that biological methods of waste treatment, particularly the activated sludge process, must be conducted under very closely controlled and well defined conditions to produce satisfactory results. For example, it is often inferred that the pH must be controlled within the range of seven to eight, that radical variations in temperature are highly detrimental, and that the sludges must be fed daily to prevent self destruction.

"A great many industries produce wastes which do not fall into the so-called optimum pH range of seven to eight. Nearly all operate on an intermittent basis which often allow wide fluctuations in temperature and prolonged periods of starvation to occur. The problem of starvation periods could be of considerable importance in industries which close down for two or three week vacation periods. Not many industries are fortunate enough to have acid and alkaline wastes produced in sufficient quantities to yield a composite waste in the pH range of seven to eight.

"Since purchase of acid or alkali for neutralization may be necessary, it becomes important to determine the extent of pH adjustment that is required. From an engineering viewpoint, it might be more economical to build a larger treatment plant and operate at a less favorable pH level to avoid excessive neutralization costs.

(continued on page 66)

NO Reducing Valve Needed

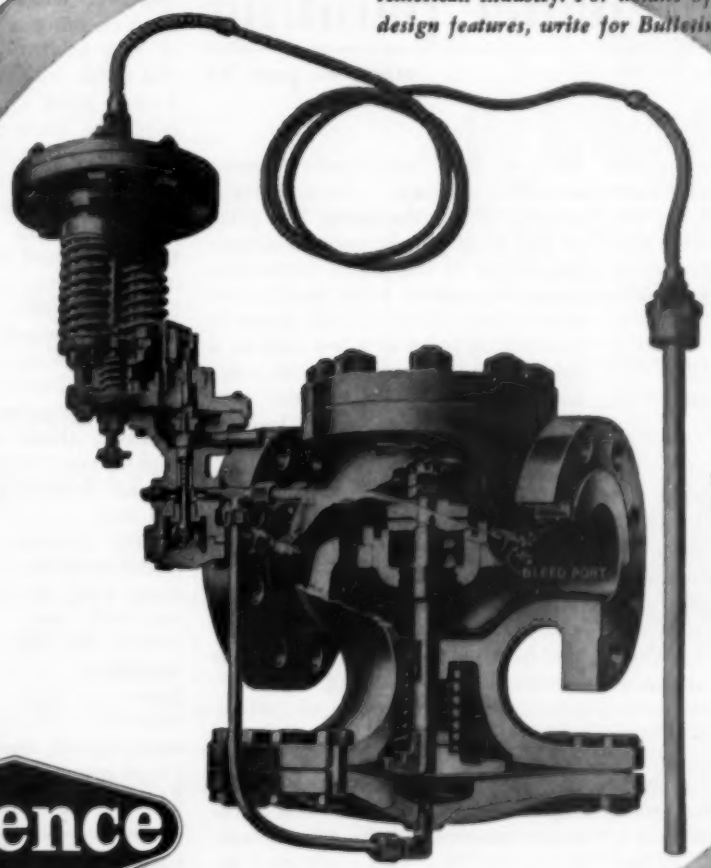
Here's real economy in temperature control.

Because Spence Temperature Regulators are designed to limit heater steam pressures to an adjustable maximum, the need for a separate reducing valve is completely eliminated.

The Spence Regulator takes steam directly from the boiler or high pressure line, reduces the pressure and regulates the flow as required to maintain a constant temperature output from the heater.

This means one relatively small combination pressure and temperature regulator replaces a reducing valve of the same size and a larger temperature regulator. Practically the entire cost of the large separate temperature regulator is saved. And, the total saving would also include the cost of a 3-valve by-pass along with all labor for installation.

This design feature is just one of the reasons for the thousands of Spence installations throughout American industry. *For details of other important design features, write for Bulletin T50.*



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Industrial waste conference

. . . starts on page 62

Limitations in the use of sanitary landfill

Wilbur C. Webb, Staff Engineer
Pennsylvania Economy League, Inc.

"Many industries do have submarginal land within their property which can advantageously be used for purposes other than building sites when properly filled under a well engineered sanitary landfill program. Filled land can be readily used for purposes other than parking lots, storage areas for materials that can be stored outside, and receiving and shipping areas."

"In larger companies private airfields can be established on recently created sanitary landfill which was previously worthless land. Employee athletic fields and recreational grounds can also be created on sanitary landfill area by industries engaged in an active employee relations program."

After listing ten desirable attributes of sanitary landfill refuse disposal, seven precautions to be followed, and seven criteria by which to evalutate the merit of sanitary landfill in a specific plant, the author concluded: "In spite of the limitations listed, careful consideration should be given to the use of this method for disposing of industrial trash. It is a relatively economical method for disposing of many types of industrial trash in a sanitary non-nuisance manner wherein both public and employee relations are, if anything, improved. A final possible advantage is the improving, and in some cases reclaiming, of submarginal land to a point where the industry can derive benefits from that land."

Your maintenance painting

. . . starts on page 54

Much unnecessary repainting can be eliminated where painting is for decorative purposes by the use of suitable washing procedures employing selected detergents or cleaning compounds. Good appearance is then maintained by occasional spot priming and building up bad areas to the thickness of the surrounding area. The appearance is restored by a finish coat.

Select system wisely

Proper selection of materials depends upon a knowledge of the deteriorating influences in the environment, and of the resistance of the material. Unfortunately, the most resistant materials are the poorest wetting and adhering. They require exacting surface preparation. If the paint system was properly selected in the first place, then premature breakdown should not occur. Failure should be by gradual erosion or failure of the finish coats of paint. This is the test of a satisfactorily selected and applied paint system. Excessive breakdown due to rusting, underfilm corrosion, undercutting by rust, are all indications of poor surface preparation, poor application, or poor selection.

Paints should be selected on the basis of their nonvolatile content and the coverage obtained for a given dry film thickness. The price of the paint can be quite misleading. Some of the more expensive paints may prove to be much more economical. There is little sense in purchasing paint at a low cost as a result of it being diluted with volatile thinners. (Some paints, particularly synthetic resin lacquer types, cannot be procured in high-solids concentrations because the resins are not very soluble.)

Specifications for painting have been organized by The Steel Structures Painting Council into nine paint systems that cover most situations[2]. They are:

¶ oil base paint systems for weather exposure with cleaning (hand or power tools), two coats of rust inhibitive oil base priming paint, and finish coat (oil, alkyd or phenolic).

¶ alkyd paint systems for weather exposure, high humidity, and infrequent immersion with blast cleaning or pickling, two coats rust inhibitive alkyd primer and finish coat of alkyd paint (phenolic for very wet locations).

¶ phenolic paint systems for fresh water immersion, alternate immersion, high humidity and condensation and weather exposure, with blast cleaning or pickling, two coats of rust inhibitive phenolic primer and finish coat of phenolic paint.

¶ vinyl paint systems for chemical exposure, fresh and salt water immersion, alternate immersion, high humidity and condensation, and weather exposure, with blast cleaning or pickling, wash primer pretreatment, and three or four coats of vinyl paint.

¶ paint systems for hand-cleaned water immersed steel (for fresh water immersion, alternate immersion, high humidity and condensation, and weather exposure), with cleaning (hand or power tool), a coat of rust inhibitive oil base or special phenolic paint, and phenolic top coat.

¶ paint systems for vessels and floating equipment, marine structures with vinyl paints, and interiors with rust inhibitive alkyd primer and one or two colored finish coats.

¶ one-coat shop paint systems for structural steel, with nominal cleaning and one coat of paint.

¶ rust preventives (thick film).

¶ bituminous coatings.

References:
1. Steel Structures Painting Manual, Volume 1, Good Painting Practice; Steel Structures Painting Council. Published 1954, Pittsburgh, Pa.
2. Steel Structures Painting Manual, Volume 2, Systems and Specifications; Steel Structures Painting Council. Published 1955, Pittsburgh, Pa.

coming events

. . . for industry & power

July 12-14	Western Plant Maintenance And Engineering Show	Pan Pacific Auditorium Los Angeles
Aug. 15-19	AIEE (Pacific General Meeting)	Butte, Montana
Aug. 22-23	National Industrial Conference Board (National Symposium — Electronics and Automatic Production)	San Francisco
Sept. 12-16	ASME and ISA (Annual Conference and Exhibit)	Shrine Exposition Hall Los Angeles
Sept. 12-16	Illuminating Engineering Society (National Technical Conference)	Statler Hotel Cleveland
Sept. 26-30	Atomic Industrial Trade Fair	Sheraton-Park Hotel Washington, D. C.
Sept. 27-29	Electrical Progress Show	Convention Hall Philadelphia
Oct. 3-7	AIEE (Fall General Meeting)	Morrison Hotel Chicago
Oct. 10-12	American Society of Lubrication Engineers (Lubrication Conference)	Antlers Hotel Indianapolis
Oct. 12-15	Eighth National Chemical Exposition	Coliseum Chicago
Oct. 17-19	AGA (Annual Convention)	Los Angeles

coming next month in
INDUSTRY & POWER . . . .

a lesson in heating with

high-temperature water

Ever wonder if you could use the efficiency of high-temperature water for space heating? If you have a multi-building plant, you will want to read next month's story on the $4,000,000 installation at McGuire Air Force Base. The 6,000-hp plant serves almost a hundred widely dispersed buildings through 33 miles of underground piping. It is truly a lesson for industry.

watch for the August issue
INDUSTRY & POWER

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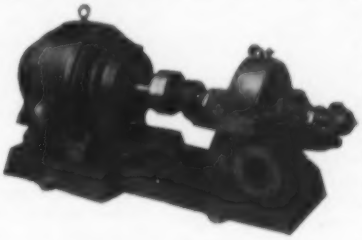

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AIR CLEANING & DUST COLLECTION

233—Using dust collectors

Dust collectors, including cyclone, wet or dry dynamic, and cloth screen arrestor types are the subject of a 32-page bulletin. Uses of air conditioning, ventilating, conveying, drying, and cooling units are presented. KIPP & BLUM MFG. CO.

234—Dust collectors and arrestors

Series of four folders describes cyclone type collector and portable, standard, and automatic bag-type dust arrestors. Also includes 32-page catalog describing exhaust fans for dust collecting and air handling. NORTHERN BLOWER CO.

AIR CONDITIONING—HEATING & REFRIGERATION

235—Heat exchanger operation

Air-flow diagram in two-page Data Sheet 124 graphically shows operation of the Aero Heat Exchanger for water, oil, or compressed air cooling. How the unit saves cooling water, piping, pumping, and equipment costs is explained. NIAGARA BLOWER CO.

236—Cooling tower is shorter

Four-page Bulletin 5.1.902 describes the LoLine, an all-new cooling tower, specifically designed for air conditioning applications—with the lowest silhouette of any tower of 75 ton capacity or larger. Each component of the tower is discussed separately and a typical cross-sectional drawing shows operation. J. F. PRITCHARD & CO.

BOILERS & STEAM

237—Water-tube generator specs

Completely packaged Water Tube Type D Superior Steam Generators in 17 sizes, with capacities from 8000 to 40,000 lb of steam per hr, are described in detail in eight-page Catalog 5M-54. SUPERIOR COMBUSTION INDUSTRIES, INC.

238—Modern ways of burning coal

"Burning Bituminous Coal the Modern Way," contains 24 pages of case histories from industries of all sizes and types. Engineering survey results for equipment include annual fuel consumption and operating costs. BITUMINOUS COAL INSTITUTE.

239—Versatility of spreader stokers

Spreader stokers said to be adaptable to all types and makes of modern steam boilers and generators, from 5,000 to 75,000 lb per hr steam output capacity, are described in 14-page Brochure 800. Various installations using Roto-Stoker Type CC stokers are shown. DETROIT STOKER CO.

240—Get free boiler survey

Here's how to get a boiler survey without obligation. Write for this bulletin covering the new CB self-contained boiler. Illustrations of installations, cut-away views of the boiler, and articles on how the units have proved themselves in specific applications are included. Four pages. CLEAVER-BROOKS CO.

241—Steam cost calculator

Made of heavy board, this Steam Cost Calculator will enable you to read directly cost of steam per hp for installations using oil, coal, or gas. It also gives a direct reading of efficiency of the system. HAPMAN DUTTON CO.

242—Vertical unit boiler

More than 25 years of development, manufacturing, and application experience are reflected in the design of the Type VU-10 vertical-unit boiler described in 16-page Bulletin VU 10-8. Advantages and design features are discussed. COMBUSTION ENGINEERING, INC.

243—Handbook on startup

Handbook covers washing out new boiler, putting it in operation, handling in service, firing methods, and shut-down. Includes big section of everyday engineering data. 48 pages. TITUSVILLE IRON WORKS CO.

244—New tube cleaner

Bulletin 44 introduces a new geared tube cleaner for removing scale in heat exchanger and condenser tubes of ⅜ to 2½ in. ID. The unit is said to be particularly effective where conditions require low speed and great power. AIRETOOL MFG. CO.

245—Water-tube steam generator

Packaged water-tube steam generators, Type MH, furnished for oil or gas firing or both, with automatic, semi-automatic, or manual combustion controls, are covered in detail in 16-page Bulletin MH3-54. UNION IRON WORKS.

246—Better ash handling

Boiler plants can enjoy efficient ash handling with the use of the system described in Data Sheet Za. The system is designed to convey boiler bottom ash and fly ash in a dry state to a temporary storage silo for ultimate disposal. It employs a steam jet exhauster to produce necessary vacuum. The silo, furnished with an unloader that mixes water with the ash, is also covered. Four pages. THE ALLEN-SHERMAN-HOFF CO.

247—Sturdy scotch boilers, stokers

How 93 years' experience in boiler manufacture pays off in better construction is described in Bulletin 236. Gives complete data and test results. Sizes range from 6 hp to 250 hp. Twenty-eight pages. THE JAMES LEFFEL & CO.

BUILDING MATERIALS & MAINTENANCE

248—Repair leaks with cement

Text and illustration in this 48-page handbook present repair methods for leaks in pipes, boilers, radiators, concrete, cinderblocks, and sheet and plate metal. Directory describes 12 repair cements and jobs they will do. SMOOTH-ON MFG. CO.

COMPRESSORS & BLOWERS

249—Are you wasting air?

"A Better Air Power System," Folder 213A points out that power losses in compressed air lines are frequently as high as 30 to 50 percent. It describes just how to go about finding out if more air is being wasted than the repair and renovation of the distribution system would cost. Six pages. INGERSOLL-RAND CO.

CORROSION CONTROL

250—Handy protective coating chart

Tables of properties, application techniques, and industrial uses are offered in Catalog 2-55-3M. Twelve pages. AMERCOAT CORPORATION.

251—Newest paints described

"Subox and Subalox Anti-Corrosive Paint — 30th Anniversary," replaces the 25th anniversary issue you have in your files. It covers these paints as previously made and includes the newer varieties. Case histories show successful use of Subox paints on various types of industrial equipment. SUBOX, INC.

252—Facts, figures on air breakers

Bulletin 5107-DR-1 contains four pages of facts, figures, features, and photo-

Boiler Refractories

Bulletin R-36

CONTENTS:

How important are Refractories? Discussion of basic requirements of refractories and critical refractories areas in boilers. PAGE 3

What causes Refractories to fail? Includes discussion of hot load strength, spalling, shelling, slagging, abrasion, erosion, shrinkage and expansion. PAGE 5

Description and Properties of:

FIREBRICK PAGE 7

INSULATING FIREBRICK PAGE 9

REFRACTORY CASTABLES PAGES 11 AND 13

REFRACTORY PLASTICS PAGES 14 AND 15

REFRACTORY MORTARS PAGES 14 AND 15

Marine Boilers PAGES 16 AND 17

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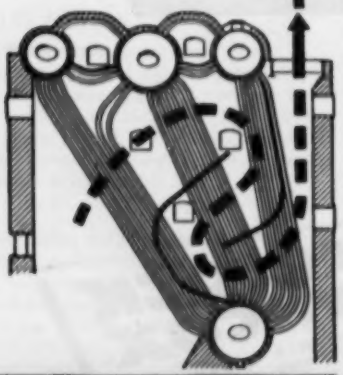

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graphs on types KA, KB, KC, and LG Urelite air circuit breakers, and on weatherproof and dust-tight enclosures. I-T-E Circuit Breaker Co.

253—Low-voltage air breakers

Low-voltage dead-front breakers with positive displacement trip devices in ratings of 600 volts ac, 40 to 1,600 amperes continuous, and 25,000 to 50,000 rms amperes interrupting capacity are described in Bulletin 18B8252. Typical thermal trip curves are included. Six pages. Allis-Chalmers Manufacturing Company.

254—Current limiting fuses

Hi-Cap fuses for the protection of loads above 600 amp are described in six-page Bulletin HCS. Two handy charts are included: Current Limiting Effect and Opening Time Curves. Use of these fuses in conjunction with Fusetron fuses is explained. Bussmann Manufacturing Co.

255—Improved solid shaft motors

Improved types of U. S. vertical solid shaft motors, including Unimount motors in ratings from ¼ to 400 hp in grease and oil lubricated types and U.S. footless type horizontal motors for direct connection, are illustrated and described in Bulletin 1868. U. S. Electrical Motors, Inc.

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256—Outdoor service equipment

Designed to make easier the selection of outdoor service equipment, 12-page Bulletin 2016 combines descriptive data on all available standard equipment—service entrance, receptacle type, dual control, three-phase units. Heinemann Electric Co.

ELECTRIC UTILIZATION

257—Surface heating

"Handy Selector Guide for Surface Heating," four-page Folder GEA-6146, shows which type of heater to use for specific jobs, how to determine heater rating, how to calculate heat-up time, and how to select thermostats. General Electric Co.

HEAT EXCHANGERS & WATER HEATERS

258—Heat exchange equipment specs

This 16-page bulletin gives all pertinent specification data for hot water storage heaters, instantaneous and converter heat exchangers, instantaneous and converter water heaters, and fuel oil heaters. Patterson-Kelley Co., Inc.

INSTRUMENTS & CONTROLS

259—Control valve reference book

Three basic types of single seated diaphragm control valves are discussed in 15-page Bulletin 5304. Cut-away views and charts with complete specification data make this a good reference book. Leslie Co.

260—Air switches divert pressure

A broad line of pneumatic switches is available for surface or flush mounting. A gradual switch that slowly increases delivery pressure is also described in Bulletin 357. Two pages. The Powers Regulator Co.

261—Automation dictionary

This "Automation Dictionary" covers some 87 words and phrases in the expanding vocabulary of automation. These are not standard engineering definitions but new engineering terms defined for the understanding of the average engineer. Minneapolis-Honeywell Regulator Co., Industrial Div.

262—New combustion sampling

The full story of a newly developed sampling system for continuous trouble-free sampling and oxygen measurement of combustion processes is told in Bulletin 703. The equipment described is designed for steam generating plants, rotary kilns and driers, open hearth furnaces, and tanks. Arnold O. Beckman Co., Inc.

263—Measure feedwater gas

Described in four-page Folder 148BP is an analyzer for measuring dissolved oxygen and hydrogen in feedwater. Advantages, ranges and accuracy are discussed. Cambridge Instrument Co., Inc.

LUBRICATION

264—Diesel lubrication revised

Written for everyone interested in the lubrication of diesels, "Lubrication of Diesel Engines," has been revised as Technical Bulletin B-1, 48 pages. It discusses diesel principles and design, types of engines in use, operating cycles, accessories and choice of lubricants. Sun Oil Co.

265—Portable oil maintenance

New portable line of oil filters makes possible on-the-spot maintenance of lubricating and industrial oils. Bulletin 316 also includes information, illustrations,

and references about combination oil filters and reclaimer units. These units are ideal for filtration and vacuum vaporization of water and other volatile contaminants in turbine, diesel, transformer, transmission and hydraulic oils. Four pages. THE HILLIARD CORPORATION.

MATERIALS HANDLING & STORAGE

266—Story of tile storage bins

"Vitrified Glazed Tile Industrial Storage Bins," four-page Bulletin 1153-B, tells you how this type of bin can keep materials clean, dry, and ready for use. Drawings show how the tiles are constructed and the simplicity of erecting silos made of these tiles. KALAMAZOO TANK AND SILO CO.

267—How idlers are used

Four-page Bulletin LD-103 shows how the Limberoller flexible belt conveyor idler is being used in industry for above or below ground belt conveyors handling various types of materials. Dimensions and specifications are listed. JOY MFG. CO.

268—Belt conveyor design data

Engineering data required to design a belt conveyor for any application are presented in 86-page Catalog 852. The booklet, published to serve as a handbook on conveyor design, states that many problems can be answered by using a standardized unit. THE JEFFREY MFG. CO.

PIPING, VALVES & SPECIALTIES

269—Pressure valves for all ranges

Catalog 10 describes List 960 and 990 valves. The 960 is for a pressure range of 200 lb at 100 F to 380 lb at 1,000 F. The 990 is for higher pressures. CHAPMAN VALVE MANUFACTURING CO.

Torque wrenches in wide range

Both inch-pound and foot-pound torques are described in this complete 68-page Catalog. Types included are for a wide range of drive sizes with plain or ratchet head. *Please send requests directly to Proto Tool Co., Dept. IP, 22762 Santa Fe Ave., Los Angeles 54, Calif., with 10c.*

271—Avoid clogging steam equipment

You can prevent rust, scale, and dirt from clogging steam equipment with use of Yarway fine-screen strainers, according to six-page Bulletin S-204. Tables give prices, rates, dimensions, and woven screen data. YARNALL-WARING CO.

272—Steam-jacketed valves

"Viscous Materials," four-page Folder E-200, will be of special interest to engineers of plants in which viscous materials are handled. Illustrations of steam-jacketed valves include a large cross section and an exploded view. EVERLASTING VALVE CO.

273—Advantages of steel unions

Advantages of a patented, inexpensive steel union of new design, with one inserted bronze seat and polygonal pipe ends, made of rugged pipe coupling stock, are pointed out in Bulletin P-100. DART UNION CO.

274—Steam traps and specialties

Catalog 68G, 31 pages, describes and illustrates steam traps, strainers, regulating and reducing valves, separators, and vacuum and lifting traps. STRONG, CARLISLE & HAMMOND COMPANY.

275—Data on pipe fabrications

Specifications for all sizes of pipe from ⅛ to 24 in. in diameter are presented in 16-page Catalog 575C. Tables give data and descriptions of standard, extra strong, and double extra heavy pipe, spiralweld pipe, large OD pipe, line pipe, electric-weld tubing, welding fittings and flanges, oil well casing, and water well casing. Facilities for fabricating pipe for structural uses also are discussed. L. B. FOSTER CO.

276—Valve and regulator data

Specifications and operational data for steam, gas, air, oil, and water regulating equipment are presented in 60-page

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Catalog 54. Illustrations and descriptions are included for pressure, temperature, and combination regulators, diaphragm, float, motor, solenoid, pop, and relief valves. O. C. Keckley Co.

277—How to select flexible hose

Cut-away diagrams and photographs illustrate construction and applications of flexible metal hose in Bulletin 147. Includes full engineering data and section on selection. Twelve pages. Flexonics Corporation.

POWER TRANSMISSION-MECHANICAL

278—Why not eddy-current brakes?

Standard eddy-current brakes and associated controls in both air and liquid cooled types are described in 11-page Bulletin BR-1. Construction details, capacities, characteristic curves, and dimensions are listed. Dynamatic Div., Eaton Mfg. Co.

279—Poly-V belt drive

Design characteristics of the Poly-V drive, a single, endless belt with molded length-wise ribs, are explained in eight-page Folder 6638. Line drawings and text compare the Poly-V with conventional drives and point out advantages. Manhattan-Rubber Div., Raybestos-Manhattan.

PUMPS

280—Centrifugal pump specs

Centrifugal Pumps—Four-page Bulletin 519-A gives complete information on the Type SB horizontally split case, double balanced suction pumps including dimensional drawings. Weinman Pump Mfg. Co.

281—Opposed impeller pump

How opposed impellers balance axial thrust is covered in 12-page Brochure 1502. Sizes from 2 to 4 in., with 2 to 8 stages, are presented for capacities to 1,000 gpm, pressures to 1,200 psig, and temperatures as high as 350 F. DeLaval Steam Turbine Co.

282—General purpose pumps

How to determine total head against which pump must operate is only one of the valuable sections in 12-page Bulletin 353-1000 on the Bilton pump, a general purpose pump suitable for medium and low head service. Byron Jackson Co.

REFRACTORIES & INSULATION

283—How to select refractory

"Boiler Refractories," 20-page Bulletin R-36, has been designed to provide operators of stationary and marine boilers with an authoritative guide for selecting the most efficient and economical refractories for their boilers. Babcock & Wilcox Co., Refractories Div.

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STEAM TURBINES

284—How steam turbines work

For a clear picture of how single-stage steam turbines operate, you will want Bulletin 1954C. Information on availability of various frames for single-stage applications, details on variable speed governors, and other features are included. Eight pages. Worthington Corp.

WASTE DISPOSAL

285—Waste problems solved

How this company has solved waste treatment problems for such industries as electro-plating, refinery, gas, and metal finishing is treated in detail in six-page Booklet 70-B. Infilco, Inc.

WATER TREATMENT

286—Water treatment explained

"Water Conditioning—One Source for Every Need," 19-page Bulletin 611B, presents the wide range of products available from this company and explains how each type solves particular problems. Elgin Refinite Div., Elgin Softener Corp.

287—All phases of purification

"Boiler Feedwater Treatment," 19-page Bulletin BFT-1, covers Inversand zeolite softeners, color process chemical softeners, and demineralizing units, including silica removal by ion-exchange. Hungerford & Terry, Inc.

288—Spray-atomizing deaerators

Spray-atomizing type units are shown in cross-section in four-page Booklet 400. Function, design and operation, construc-

(more bulletins on page 78)

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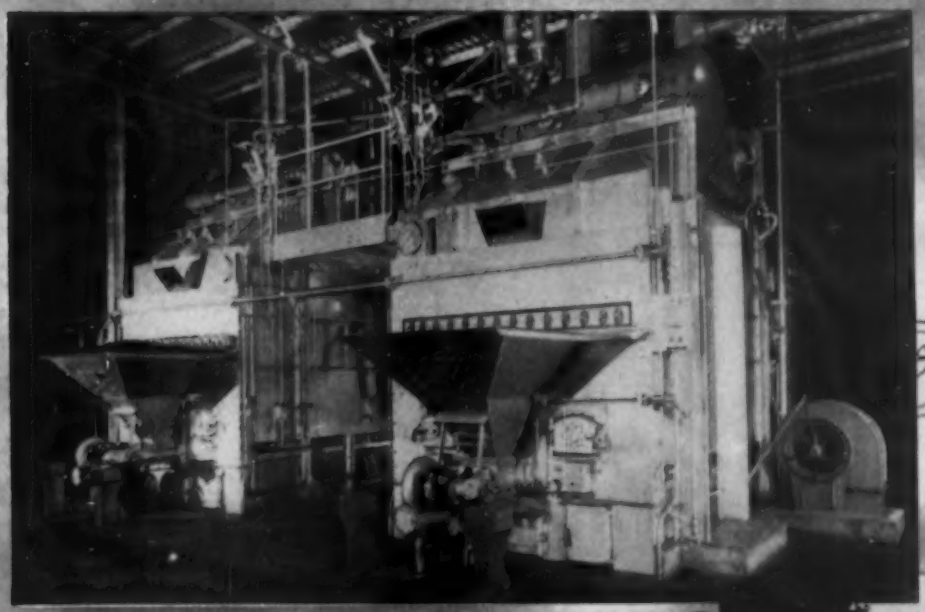

Steam Plant, Pinehurst, Incorporated, showing Detroit Single Retort Stokers. Boilers are Babcock & Wilcox Integral Furnace Type FF.
John F. Taylor, *Manager Utilities . . .*
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The Carolina Hotel, Pinehurst, N. C.—the largest of the three hotels served by this modern plant.

Cost of steam per thousand pounds has been reduced 28½% by the new stoker—boiler installation, according to Mr. John F. Taylor, Utilities Manager, Pinehurst, Incorporated, Pinehurst, N. C. Amount of steam generated per pound of coal has been increased 22%.

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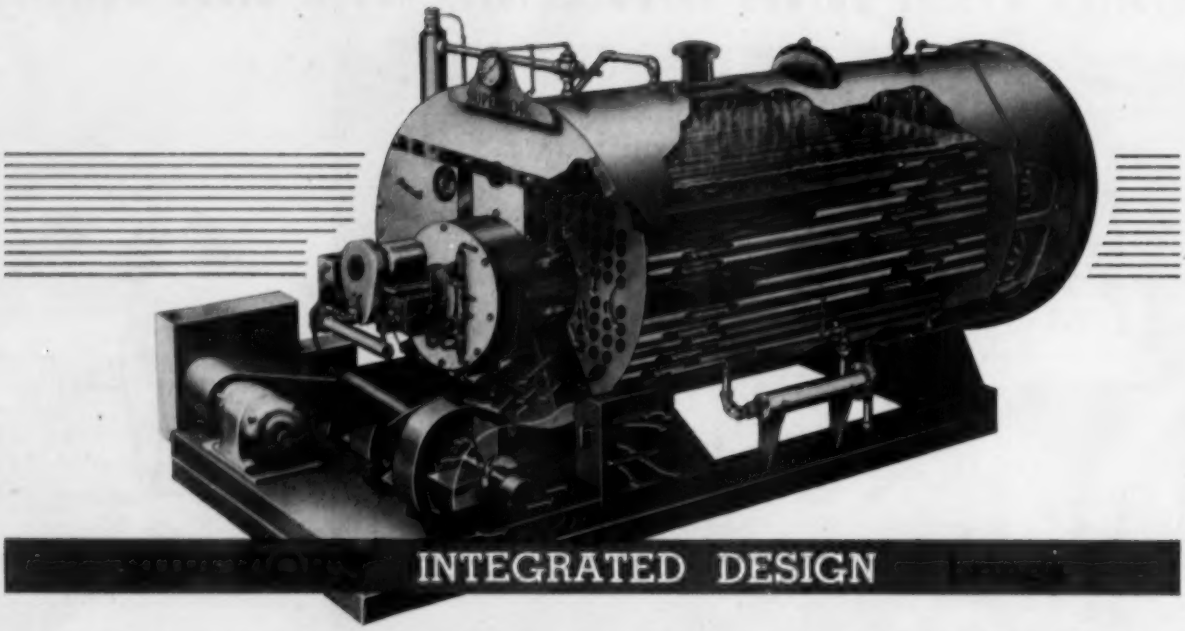

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Detroit Stoker Company. Want to reduce the cost of steam? Detroit Stoker bulletins show how. Write for them now.
Read page 73 and circle number 528.

Diamond Power Specialty Corp. Diamond "multi-port" bi-color gauge is earning wide acceptance everywhere. It offers excellent readability and substantial savings in gauge maintenance costs. Bulletin 1174.
Read page 24 and circle number 515.

The Engineer Company. Extra power quickly! Fuel saving baffles provide power quickly and easily. Send for Bulletin BW 40 on modern baffle wall construction.
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Erie City Iron Works. There's steam economy in flexibility. Use multiple Erie City Keystone steam generators. Write for Bulletin SB-51 describing the fully automatically controlled Keystone.
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Heacon, Inc. Heacon does it. Clean your air pre-heaters while the boiler operates at half load! Write for more information on Heacon dampers.
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Henszey Company. Continuous blowdown assures complete, automatic control of boiler water concentration. Free blowdown chart.
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The Liquidometer Corp. Liquids worth storing are worth measuring with a liquidometer tank gauge.
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National Coal Association. Want to save money? Cut fuel costs. Write for further information and case histories.
Read page 27 and circle number 516.

Superior Combustion Industries, Inc. Superior's integrated design assures low cost steam. Sizes 20 to 600 hp steam or hot water. Catalog 702.
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The Gustav Wiedeke Company. For modern water-tube boilers use Series 1500 tube expanders. Write for Bulletin.
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The Master Builders Company. Do you have grouting problems? Embeco premixed grout will give you lasting results. Write for eight-page illustrated booklet.
Read page 84 and circle number 535.

Subox, Inc. Get five to eight years protection from a single coat of Subox. Write for a free copy of "Corrosion Control of Electrical Structures and Equipment."
Read page 89 and circle number 542.

Electrical equipment

Bussmann Mfg. Company. Cut motor repairs by installing Fusetron fuses. Bulletin HCS gives details.
Read page 28-29 and circle number 517.

FIRST CLASS
PERMIT No. 19
(Sec. 34.9, P.L.&R.)
ST. JOSEPH, MICH.

BUSINESS REPLY CARD
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COMMERCIAL BANK BLDG.

ST. JOSEPH, MICH.

handy guide

. . . continued from preceeding page

I-T-E Circuit Breaker Company, Small Air Circuit Breaker Division. I-T-E plug-in mounting for molded-case circuit breaker switchboards offer advantages you get only in this modern, streamlined construction. Underwriters Laboratories Inc. approved.
Read page 93 and circle number 545.

I-T-E Circuit Breaker Company, Switchgear Division. New developments in I-T-E low-voltage switchgear permit the use of lower-interrupting-rating breakers for short-circuit protection. You save. Send for information on new proposed industry standards.
Read page 32-33 and circle number 519.

Coppus Engineering Corp. Keep up efficiency and morale. Coppus blowers and ventilators will give you better air. Check the coupon for your special ventilating problems.
Read page 21 and circle number 513.

Pick Manufacturing Co. Pick instantaneous hot water heaters are engineered for service. Write for the booklet on how Pick heaters cut cost of hot water.
Read page 71 and circle number 526.

The Powers Regulator Co. Control that temperature! Fifty percent more power than majority of regulators. Bulletin 329.
Read page 85 and circle number 538.

Instruments and controls

Ernst Water Column & Gage Co. For high-pressure gage glasses, order from Ernst. Made in a variety of lengths and diameters. Send for catalog.
Read page 88 and circle number 541.

The Hays Corp. The new Hays Gaspirator system can solve your difficult gas sampling problems. Bulletin 55-829-56.
Read page 23 and circle number 514.

The Liquidometer Corp. For gauging liquids of all kinds. One hundred percent automatic. Underwriters Laboratories approved. Write for complete details.
Read page 92 and circle number 543.

Lubricants

Sinclair Refining Co. Sinclair RUBILENE for better diesel performance prevents excessive wear of moving parts—pays off in lower maintenance costs. Write for further information.
Read page 7 and circle number 503.

The Texas Co. Want maximum efficiency from your turbines and power plant auxiliaries? Texaco Regal Oils will meet the most stringent requirements. Write for lubrication engineering help.
Read page 94 and circle number 546.

Materials of construction

L. B. Foster Co. Use Foster relayers to install and maintain rails. Send for catalogs to help you save on rails.
Read page 88 and circle number 540.

Kirk & Blum Mfg. Co. Fabrication of control panels and desks for industrial plants and utilities is a Kirk & Blum specialty. Quotations on request or write for copy of the fabrication catalog.
Read page 87 and circle number 539.

Packing and gaskets

Johns-Manville Corp. Now J-M introduces Chempac-Interlocked Packing which is heat, chemical, and wear resisting. Send for free folder PK-80A.
Read page 17 and circle number 510.

Pipe, tubing & hose

Atlantic Metal Hose Co., Inc. For every application Atlantic has a flexible metal hose that is job tested and certified. Catalog 500.
Read page 8 and circle number 504.

Henry Vogt Machine Co. Here is an exchanger that can be cleaned while in operation! Bulletin HE-7 describes the flexibility of design and use.
Read page 9 and circle number 505.

Pumps and compressors

The Weinman Pump Mfg. Co. Use Weinman expert experience to solve your pumping problems. A wide range of models are available.
Read page 67 and circle number 523.

Refractories and insulation

Babcock & Wilcox Co. New 20-page handbook locates critical refractories for you. Send for it today. Bulletin R-36.
Read page 69 and circle number 524.

Bigelow-Liptak Corporation. World-wide performance of B-L's refractory installations show exceptional durability and performance. Write for the catalog "One Source" describing B-L's complete castable package.
Read page 3 and circle number 501.

Steam specialties

Armstrong Machine Works. Armstrong steam traps make a world of difference in performance of equipment and cost of maintenance. Send for "The Handbook of Steam-Trapping." It helps you analyze your problems.
Read page 2 and circle number 500.

Airetool Mfg. Co. Want proof of the rapid and efficient tube maintenance done by Airetool equipment? Ask for a demonstration.
Read page 78 and circle number 530.

Erie Bolt & Nut Co. When it's time for a specialist in bolts and studs, send for Erie. Forty years' experience in high quality precision work.
Read page 18 and circle number 511.

PROTO Tools. Give your work the professional touch. PROTO provides the right power or impact socket you need. Send for catalog of the entire line of Plomb Tool Company.
Read page 6 and circle number 502.

Valves and regulators

The Annin Company. For remote shut-off applications, try Annin. Absolute dependability and safety. Send for details.
Read page 13 and circle number 507.

The Chapman Valve Manufacturing Co. Most widely used small forged steel gate valve in the world is the Chapman List 960. Catalog 10 shows specifications and applications.
Read page 63 and circle number 521.

O. C. Keckley Company. Whatever your requirements, a Keckley pressure regulator can be engineered to fit them. Used on steam, gas, or air. Handbook No. 55-E contains complete information.
Read page 82 and circle number 533.

Leslie Co. Control both temperature and pressure automatically with the Duomatic temperature regulator for controlling steam flow. Bulletin 5307.
Read page 79 and circle number 531.

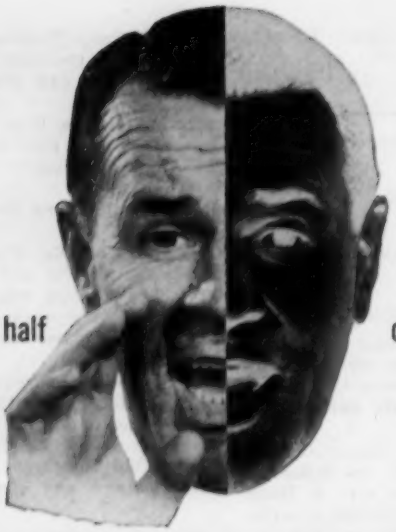
Spence Engineering Company, Inc. For real economy in temperature control, Spence offers a temperature regulator that eliminates need of a reducing valve. For details of important design features and engineering, write for Bulletin T50.
Read page 65 and circle number 522.

Yarnall-Waring Company. Have you checked your blow-off valve lately? Write for the free Check Sheet and Yarway Catalog B-426.
Read page 34 and circle number 520.

Water treatment

W. H. & L. D. Betz. Do you have a water conditioning problem? Betz offers study by specialists.
Read page 11 and circle number 506.

Hungerford & Terry, Inc. For complete water treatment plants and water conditioning systems, H & T offers specialized service. Send for Bulletins. Specify your needs.
Read page 85 and circle number 537.



don't miss half of the picture . . .

SEE AIRETOOL AT WORK!

Convincing proof of the rapid and efficient tube maintenance done by Airetool equipment can only be *fully shown* on the job!

We could talk forever . . . about the complete line of cutter, drill and brush cleaner heads to fit every size of straight and curved tubes . . . or the powerful, high-speed motors that provide extra-husky driving torque, and "load down" to low R.P.M. without stalling! We could tell you about Airetool's precise slip-fit ground construction that permits easy disassembly and reassembly without special tools . . . or any of the thousand and one reasons why we know that Airetool Tube Maintenance Equipment is foremost in its field!

Words alone convey but half the picture . . . we'd rather show than tell you—so ask your nearest Airetool representative for a demonstration . . . just name the time and the place!

Just one of the many efficient AIRETOOL combinations for rapid, economical, thorough tube maintenance . . . the series "6000" ball bearing motor, shown here with a single-expansion type cutter head, and the G-800 ball bearing thrust quick-rolling expander.

WRITE TODAY to The Airetool Manufacturing Co., 328 S. Center St., Springfield, Ohio—get full information about the complete line of Airetool Tube Maintenance Equipment for your specific industrial needs.

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

Remember . . . there's an AIRETOOL Tube Cleaner and Tube Expander for Every Type of Tubular Construction.

REPRESENTATIVES in principal cities in U.S.A., Canada, Mexico, South America, England, Japan.

BRANCH OFFICES: New York, Philadelphia, Chicago, Tulsa, Houston, Baton Rouge.

Circle 530 on reply card for more data

free bulletins

. . . starts on page 68

tion, outstanding features, and uses are discussed. AMERICAN WATER SOFTENER CO.

289-Supplementary water treatment

"No. 40 Series Supplementary Treatments," three-page Booklet 28X8226, discusses supplementary treatments for boiler makeup water such as treatments for softening traces of hardness, dispersives for conditioning of sludge, oxygen scavengers, and anti-foam agents. ALLIS-CHALMERS MANUFACTURING CO.

290-Demineralizing handbook

"Handbook on Demineralizing," 40-page Bulletin 5800-B, compares various methods of water treatment including demineralizers and evaporators. It goes into characteristics of various types of available cation and anion exchange materials and operating costs. COCHRANE CORP.

FREE COPIES

For free copies of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card facing page 77.

291-Recirculation treatment chart

A method for protection of cooling water equipment and recirculating water systems is presented in Bulletin 68. Includes handy check chart to help indicate if your system would benefit from this treatment, and explains how the method works. Four pages. NATIONAL ALUMINATE CORP.

292-How to use package feeders

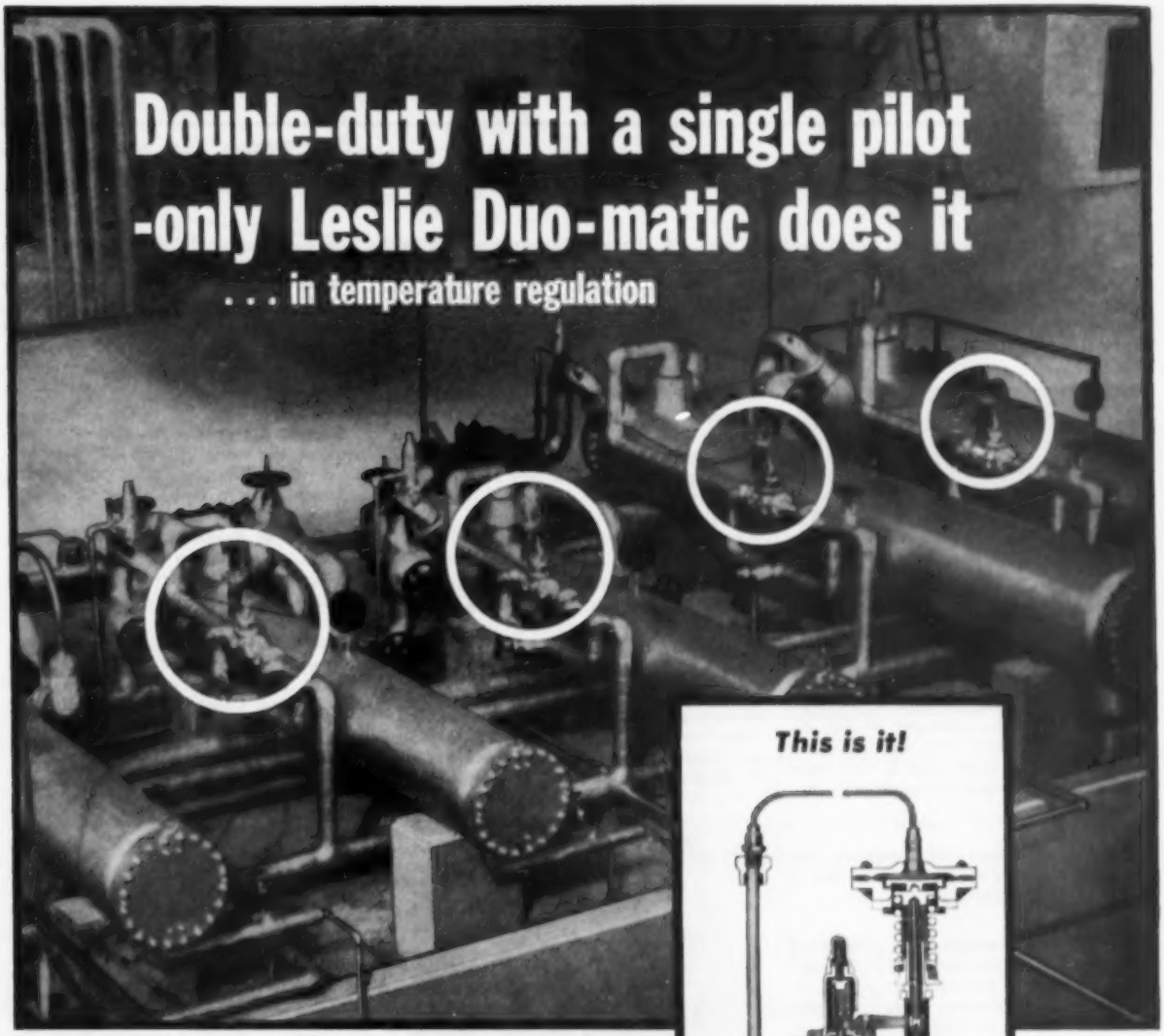
Proportioning pumps and package chemical feeding units are described in this four-page folder. With liquid ends available for about 85 percent of all chemical pumping requirements, the pump is designed for use where a controlled capacity of fluid is necessary. How the feeding unit can be connected to the piping of your plant and to the electrical control equipment is explained. BIRD-ARCHER CO.

293-Demineralization principles

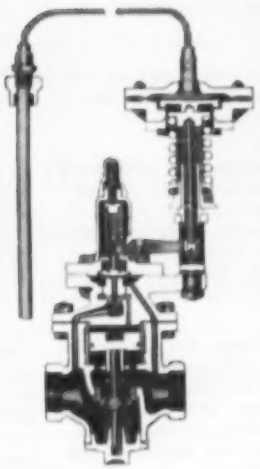
"Demineralization including Silica Removal by Ion Exchange," 28-page Booklet 3803, describes applications, principles of operation, and gives recommendations for demineralizing and silica removal apparatus and synthetic resins. THE PERMUTIT CO.

Double-duty with a single pilot -only Leslie Duo-matic does it

. . . in temperature regulation



This is it!



The Duo-matic Leslie temperature regulator for controlling steam flow is a single unit, with a *single* internal pilot valve—yet it controls automatically both temperature and pressure conditions. No hunting or cycling on low flows . . . eliminates temperature "droop" on heavy loads.

Simplified piping and better control of fuel oil heaters, instantaneous and storage type heaters, driers, process heaters, kettles, open tanks, ovens, degreasing machines, steam tables, sterilizers, etc., more than offset the initial cost of this superior regulator.

Investigate "dual-function" Duo-matic regulators — proven in service for over 19 years of applications.

Leslie Class LTCO Duo-matic temperature and pressure regulator.

WRITE FOR BULLETIN 5307

TRADE LESLIE MARK

REGULATORS AND CONTROLLERS

LESLIE CO., 263 GRANT AVENUE, LYNDHURST, NEW JERSEY

3093

CONTROLLED QUALITY MEANS QUALITY CONTROLS

Circle 531 on reply card for more data

names make news

. . . personalities from industry & power

H. K. Porter Company, Inc. has named **C. I. (Shay) Young** vice president and general manager of its Laclede-Christy Division. He was previously vice president in charge of operations at all Laclede-Christy plants.

Swengel **Allen**

The American Chain and Cable Company, Inc. has appointed **John W. Swengel** as assistant works manager of the R-P&C valve division. He was formerly foundry superintendent and is vice president of the Reading Foundrymen's Association.

The Allen-Sherman-Hoff Company has elected **B. C. Berry** chairman of the board and **H. E. Allen** president.

The Foxboro Company has appointed **C. C. Fuller** as vice president to augment the sales management staff, **H. O. Ehrisman** as general sales manager, and **J. J. Burnett** as field sales manager. Vice president **C. E. Sullivan,** who has retired, will serve as a consultant.

Pennsylvania Salt Mfg. Co. announces that **Hugh C. Land** will succeed **William P. Drake** as head of its Industrial Chemicals Division. Since 1946 Land has served Pennsalt as field engineer, maintenance and construction engineer, and assistant superintendent.

Combustion Engineering, Inc. has elected **Theodore A. Dyke** manager of the export division of its general sales department to a vice presidency in the company. During the war he served as chief of the industrial equipment group in the lend-lease administration.

General Controls Co. has appointed **Sumner Ladd** as manager of its Industrial Controls Division.

The Deming Company has appointed **Dexter F. Anderson** as district representative in the Far Western states. He will cover ten states west of the Rockies.

Metal & Thermit Corporation has acquired the services of **James L. Oberg** as technical advisor. He will handle special assignments on metals, Thermit and electric welding processes.

The Swartwout Company has appointed **Process-Instrument Systems, Ltd.** as Canadian representatives for its Autronic Process Controls Division for Ontario and the Maritime Provinces. They also appointed **The Whitney M. Kerr Co.** as its representative for power plant and industrial ventilation equipment in the Kansas and Western Missouri territory.

Catalytic Combustion Corporation is expanding its facilities and **Gordon F. Hubbert** has been appointed as manager of the Michigan Sales District.

General Electric Company has selected key personnel for its newly formed large lamp department. **Henry F. DeLong** is manager of manufacturing and **Vernet C. Kauffman** is manager of engineering.

Watson **Gorrie**

Worthington Corporation announces that **Ralph M. Watson,** formerly director of research has accepted an appointment as associate dean of the L. C. Smith College of Engineering, and chairman of the department of mechanical engineering, Syracuse University. **William J. Millett** has been appointed assistant vice president in charge of manufacturing of its air conditioning and refrigeration division. **Hellmuth Walter** has been named director of research and **Robert S. Sherwood** has been appointed assistant director of research.

Bailey Meter Company has elected **Paul S. Dickey** president in succession to **Robert S. Coffin** who was elected chairman of the executive committee and named management consultant. **Harvard H. Gorrie,** chief engineer, has been elected a vice president in charge of all engineering activities and **Raymond D. Junkins,** head of the patent department, has been elected a vice president and director.

Burgess-Manning Company has named **H. A. Dietrich** manager of the Libertyville divison and **F. C. Duerr** as manager of the Chicago district of the company. **Dravo Corporation** has elected **William E. Clark** as its executive vice president in succession to **Alex W. Dann** who recently retired.

Electric Controller & Mfg. Co. announces the establishment of their own office and full-time sales engineering representation in San Carlos, Calif.

The H. K. Porter Company, Inc. has promoted **O. A. Olson** from project engineer to assistant director of research at its Laclede-Christy division.

J. A. Zurn Mfg. Co. announces the appointment of **Frank P. Glazebrook** as Newark District manager of **Zurn Services,** its East Coast marketing organization.

U. S. Hoffman Machinery Corp. announces that **Clare F. Saltz** has been appointed manager of its ordnance equipment division.

Crane Co. has announced the retirement of **Vincent P. Rumely,** senior vice president and member of its board of directors.

Wolverine Tube, Division of Calumet & Hecla, Inc. announces the appointment of **Dr. Donald Q. Kern** as professional consultant in the heat transfer field. Dr. Kern is the author of the widely accepted text book "Process Heat Transfer."

Naylor **Carlisle**

The Fairbanks Company has elected **Alexander L. Naylor** president of the company in succession to his father, the late **George M. Naylor.**

Clark Controller Company has named **Ben H. Carlisle** manager of its recently established new products division. He was formerly in the applied engineering department.

(more names make news on page 82)

What are the men doing?

They are retubing the fuel economizer.

What happened to the old tubes?

Sulphuric acid ate holes in them.

Who put sulphuric acid in the fuel economizer?

Well, nobody meant to. But there was too much sulphur in the coal and when the coal burned some of the sulphur was turned to sulphuric acid.

Why did they purchase the high sulphur coal?

It figured out cheaper on the cents-per-million-BTU basis.

But was it really cheaper by the time they put the new tubes in?

No, it wasn't! And this instance shows that BTU cost is not the only factor to be considered in buying fuel. It's a matter of matching fuel to use and to equipment, and that requires close cooperation between the plant engineer and the purchasing agent.

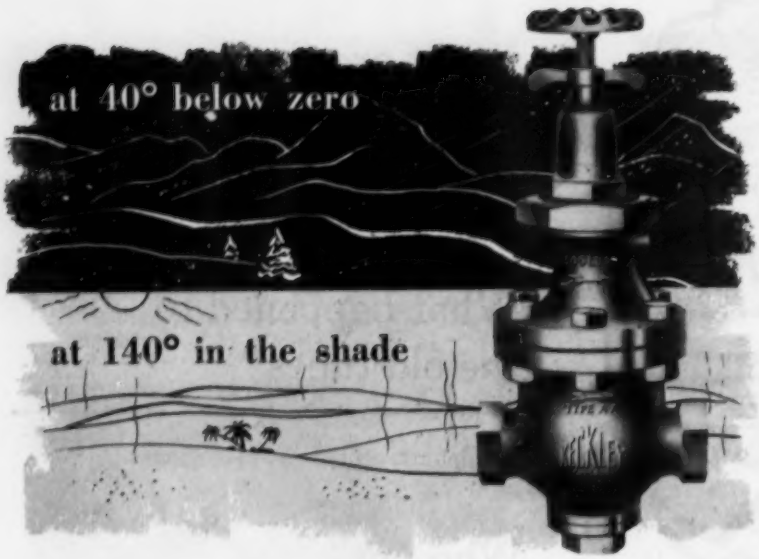
P.S.

There's a lot more to buying coal than the cost per ton. For facts and figures to solve your particular fuel requirements, write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake & Ohio Railway Company, Terminal Tower, Cleveland 1, Ohio.

Chesapeake and Ohio Railway

WORLD'S LARGEST CARRIER OF BITUMINOUS COAL

Circle 532 on reply card for more data



. . . this air and gas pressure regulator is still guaranteed to give:

POSITIVE DEAD END SHUT-OFF

All Keckley pressure regulators used in air and gas systems can be fitted with Teflon seats and discs, thus assuring positive shut-off no matter the outside temperature. The resiliency of Teflon is not affected by ambient temperature changes, thus guaranteeing dead end service. These pressure regulators are naturals for air and gas service to 600 lbs. under all temperature conditions when all moisture has been removed from the air or gas.

When handling high temperature or high pressure steam, the regulators can be fitted with a monel piston and liner and a Stellited stainless steel seat and disc.

For normal installations stainless steel main valve and seats are standard and are used on steam, gas or air.

No matter what requirements you have, a Keckley pressure regulator can be engineered to fit them. See your local Keckley Representative or write for details. Ask for the free 56 page Catalog 55-E — contains complete information about all Keckley Steam and Liquid Controls.

O. C. KECKLEY COMPANY

400 W. MADISON ST.
CHICAGO 6, ILLINOIS

Pressure Regulators • Temperature Regulators • Float Valves
Strainers • Solenoid Valves • Reducing Valves
Pop Safety Valves • Relief Valves

KECKLEY CHICAGO

Circle 533 on reply card for more data

names make news

. . . starts on page 80

Cosentini Associates, Consulting Engineers, announce that **Owen S. Lieberg** has recently joined their company. He will continue to specialize in the design of high temperature water installations, as well as radiant cooling and heating systems.

Limestone Division of U. S. Steel Corp.; T. Frederick Burris, chief engineer, **Chesapeake & Ohio Railway; Maurice J. Day,** director of research and development, **Crucible Steel Company of America; James Harold Foote,** chief engineer and president of **Commonwealth Associates, Inc.; Raymond F. Giffels,** secretary-treasurer, **Giffels & Vallet, Inc.; Stanley B. Hunt,** chief of engineering division of Buffalo district in charge of **St. Lawrence Seaway** project; **Vern L. Ketchum,** chief engineer, **Timber Structures, Inc.;** and **Arthur Vinson,** vice president, **General Electric Company.**

Kerbey

Ballard

Midwest Piping Company, Inc. has elected **Eric A. Kerbey** as its president. He has been executive vice president for the last eleven years. **A. G. Stoughton,** president of Midwest since its formation, will continue as chairman of the board and chairman of the executive committee.

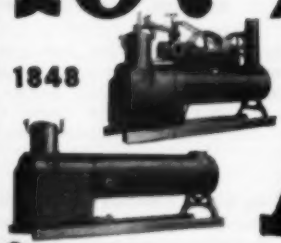
Electronics Corporation of America has acquired the services of **Drs. James W. Ballard** and **William A. Patterson,** outstanding scientists in the fields of infrared radiation and electronics instrumentation, for its research staff. Dr. Ballard will serve as assistant director of research and Dr. Patterson as head of the corporations new flame research program.

C. O. Bartlett & Snow Co. has appointed **Norman R. Kidd** as manager of its Service and Parts Sales Division.

A. W. Cash Company has appointed **John A. Wiedmann** director of research and development.

The School of Engineering of Michigan State College recently sponsored a Centennial symposium, and eight of Amer-

107 YEARS of RELIABILITY ARE BEHIND EVERY AMESTEAM GENERATOR



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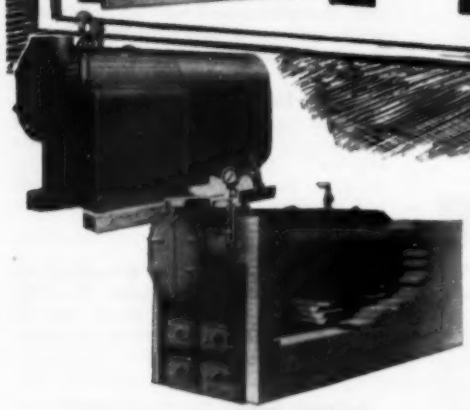

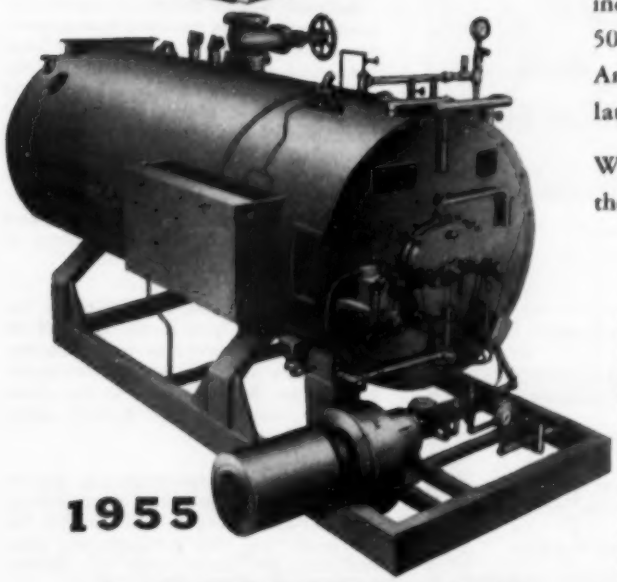

1955

AMESTEAM GENERATOR

20 sizes, 10 to 600 H.P., 15 to 200# W.P., oil, gas, or oil-gas combinations with quick fuel switchover feature.

In your selection of a boiler, it's important to remember — experience *does* count. And what better assurance of top boiler quality do you have than the Ames record: 107 years of building fine boilers — boilers which have given economical, satisfactory service throughout the industry! Many Ames units purchased 40 to 50 years ago are still faithfully on the job. Amesteam Generators always incorporate the latest advances in package boiler design.

Write today for details on these boilers with the proven record of reliability.

AMES IRON WORKS, INC.

Box F-75, Oswego, N. Y.

Show me how I can benefit from Ames experience and nation-wide organization in getting a top boiler value.

NAME .....

ADDRESS .....

COMPANY .....

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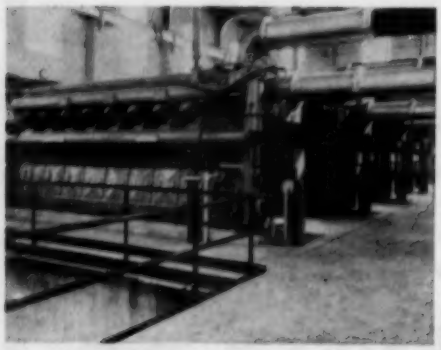
cut down shutdowns..



NON-SHRINK

EMBECO

PRE-MIXED

GROUT

Whatever the grouting job — heavy equipment, machinery, anchor bolts, building columns, etc.— Embeco Pre-Mixed Grout will give you *lasting results.*

send for booklet

Many advantages over plain cement-sand grouts—

- *Non-Shrink* with full bedplate contact... maintains alignment.
- *High Compressive and Impact-Resistant Strength*... takes vibration, pounding action.
- *Oil and Water Resistant.*
- *Flowable—Easily Placed* yet does not shrink upon hardening.

Recommended by leading equipment manufacturers.

EMBECO PRE-MIXED GROUT IS READY TO USE—you add only water. Write for 8 page illustrated booklet.

Creators and Manufacturers of Products to Improve Concrete and Mortar

THE MASTER BUILDERS CO.

CLEVELAND 3, OHIO — Subsidiary of American Marietta Company — TORONTO 8, ONTARIO

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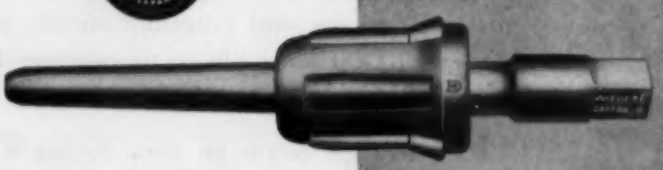
IDEAL



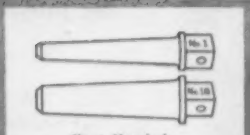
For modern Water Tube Boilers

Series 1500 Tube Expanders

. . . Recommended for use with Drum or with short Header Mandrels.

Right Angle Drive speeds-up rolling operation of any Tube inside round or square Header.

See your Dealer or write us for Bulletin.



Short Mandrels

Right Angle Gear Drive

THE GUSTAV WIEDEKE COMPANY

DAYTON 1, OHIO

Circle 536 on reply card for more data

names make news

. . . starts on page 80

ica's outstanding engineers received Centennial Awards "for outstanding contributions to society, for achieving distinction in their endeavors, and for setting the highest standards of accomplishment." The award winners are: **Christian F. Beukema**, president, **Michigan**

Chrysler Corporation has appointed **Norman R. Reno** as works manager of its Marine and Industrial Engine Division. He has previously served as marine and industrial engine master mechanic.

A. M. Byers Company has announced the retirement of **Thomas Pritchard**, general superintendent of the company's south side plant in Pittsburgh, Pa. He was the company's oldest employee.

Cooper-Bessemer has promoted **C. R. Jones** as manager of Western Canada for its Canadian subsidiary. He has been responsible for many notable contributions to the engineering of gas, diesel, and gas-diesel engines and engine-driven compressors.

Rockwell Manufacturing Company has appointed **George E. O'Brien** factory manager at its new water meter plant at Uniontown, Pa., as manager of the foundry at its Brooklyn plant.

Reliance Gauge Column Company announces that **John Rowland Brown**, president and general manager, has been awarded the grade of fellow in the ASME. His most notable achievements are in the field of heat power, instrumentation of high pressure boilers, and electrified railways.

D. W. Onan & Sons, Inc. have announced the appointment of **H. Jerome Olson** as vice president in charge of manufacturing.

American Iron and Steel Institute has announced the retirement of **Bert L. Wood** who has served as consulting engineer since 1938. He will be succeeded by **William G. Kirkland** who has been resident engineer in the western states since 1947.

Borg-Warner Corporation has elected **Harold Nutt** as president and general manager of its Borg & Beck division. He previously was vice president and general manager. He succeeds **T. L. Knecht** who retired on May 31.

The American Society of Lubrication Engineers has named **J. W. Hopkinson**, president of the Penn-Petroleum Corporation, as its new president at the 1955 annual meeting.

good books

. . . for industry and power

Steam, Its Generation and Use, 37th edition; The Babcock & Wilcox Co.; 29 chapters; $10.00.

This book, first published in 1875, represents as comprehensive an exposition on the subject of steam as may be found anywhere. It is an invaluable reference for any engineer working in the applied thermo field.

Outstanding as an indication of the book's timeliness is the chapter titled "Nuclear Power." Among the other major topics covered are sources of heat, principles of combustion, heat transfer, fluid dynamics, boiler settings, metallurgy, and care of boilers.

The typography and illustration techniques as well as the technical level make this book extremely easy to comprehend for any one with some engineering background. It is not a cook-book-style primer. Rather, it is an easy-reading source of basic information regarding generation and use of steam.

Connecting and Testing Direct Current Machines, by F. A. Annett and A. C. Roe; McGraw-Hill Book Company; 328 pages; $5.00.

This book covers modern methods for connecting direct-current motors and generators and for locating faults in their armatures and field windings. This material will be of great help to electrical engineers as well as maintenance and repair workers responsible for rebuilding d-c machines for higher ratings and longer operating life. Not only are proper tests given, but the reasons behind the results of the tests are discussed.

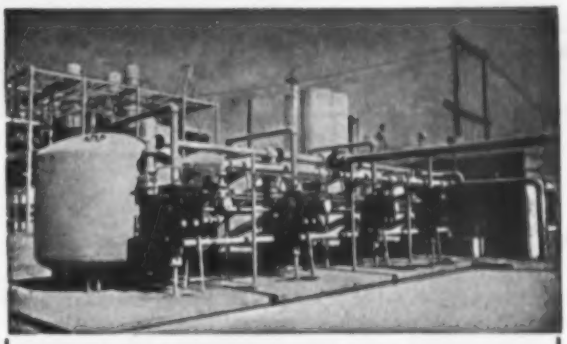
Among the features of this edition is new material on testing armature windings and field coils, high-temperature insulations, increasing the capacity of old machines, and techniques of high-frequency, low-energy, surge-voltage testing.

Activated Alumina Maintenance Program — Power System Oils; Aluminum Company of America; 120 pages; gratis.

Power system operators will find complete details in this book on the installation and operation of a system for preventing deterioration of power system oils and hydraulic oils. The book is primarily concerned with maintenance and testing procedures. Case histories are cited to show how money can be saved through the use of an activated alumina maintenance program for power system oils.

Pipe Friction Manual; The Hydraulic Institute; 87 pages, paper bound; $1.75.

This volume is a complete and workable treatise on pipe friction phenomena. It begins with a discussion of basic formulas, and then goes into extensive tabular matter giving friction loss for water in various sizes and types of pipe. Resistance coefficients for valves and fittings are given as well as monographs and other charts useful in computations of this sort. This represents a thorough and authoritative handbook on the subject.



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spot news

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• Into the crystal ball

The Twentieth Century Fund predicts that the United States is easily capable of obtaining a total national output of $414 billion by 1960, making possible an average family income of more than $6,000 per year. Prospects of still greater growth lie in the years ahead.

Among dozens of specific findings, the following are of particular interest to power services engineers: In another century we shall be able to produce as much in one seven-hour day as we now produce in a 40-hour week. The average American worker today produces nearly six times as much in an hour's work as his great grandfather did in 1850. In 1850, more than ⅛ of all the work was done by human beings, and more than half by horses, mules, and oxen. Muscle power thus accounted for slightly less than 2/3 of the work.

By 1900, the work-animal portion had dropped to 22 percent of the total, and that of human workers to 5 percent. Today, muscle power is all but gone, and inanimate energy accounts for nearly 99 percent of our much larger total work output. One man with today's power-driven mechanical equipment can do as much work in 40 hours as three men working 70 hours a week with the primitive tools of a century ago.

• Industrial park for Fort Worth

Plans have been announced for a unique 83-acre industrial park site—the only one of its type in the Southwest—tagged at $8,000,000 to $10,000,000. The development will be known as Richland Industrial Park. The area will be divided into 100 desirable industrial sites. Combining out-of-city comforts with in-city conveniences, the development will impose several protective restrictions on all tenants.

• Companies continue combining

Hays Corporation, a leading manufacturer of power plant instrumentation, announces outright purchase of the Metrotype Corporation, manufacturer of data reduction equipment. Hays' executive vice president, Phil Sprague Jr., says "We believe that Metrotype's load control is a logical adjunct to our power plant line and will allow us to take a systems-efficiency approach to the entire process of power generation and distribution. . . ." Koppers Company has purchased Kuchler-Huhn Company, manufacturer of mechanical seals for rotating shafts in high-speed, high-temperature equipment. . . . Houdaille-Hershey Corporation has acquired a group of diversified plants formerly owned by Frontier Industries, Buffalo, New York. Houdaille is further diversifying by establishing a new engineering laboratory in Pasadena, California. . . . National Valve and Manufacturing Company, Pittsburgh, has been sold to a group of investors headed by Frederick W. Richmond, New York industrialist. It is planned that Navco's expansion program will be accelerated and its expenditures on research in the piping field increased. . . . Buckeye Soda Company, subsidiary of Diamond Alkali Company, will be liquidated and absorbed by the parent firm. . . . H. K. Porter Company has created a twelfth division through purchase of the Vulcan Crucible Steel Company. . . . United States Hoffman Machinery Corporation has purchased the Intercontinental Manufacturing Company, Dallas.

• Census figures on boilers

The Bureau of the Census has just released figures showing the new orders issued in 1954 for steel power boilers. Some 5,496 units with total heating surface of 8.5 million square feet were ordered. In terms of units, this represents a decrease of three percent from 1953. In terms of heating surface area, this represents a decrease of 10 percent.

• Society notes

Newly elected president Morris D. Hooven, Public Service Electric and Gas Company, Newark, New Jersey, five new vice presidents, and three new directors will take office in the AIEE on August 1. . . .The Chicago Exposition of Power and Mechanical Engineering, to be held November 14 to 18 under the auspices of the ASME, will feature an atomic power section. The ASME's Nuclear Engineering Division will sponsor a technical program. Exhibits will disclose applications of atomic energy to power. . . . Metal engineers, scientists, chemists, and physicists are teaming up in the first major assault to be launched against one of the most costly problems facing industry: metallic corrosion. A Corrosion Research Council of the Engineering Foundation has been formed with the aid of the AIME, the Intersociety Corrosion Committee, and the Electrochemical Society. It will make a concerted effort to learn more about this industrial enemy that rolls up an annual toll of $5,000,000,000 or more. To get its "first-team" to work, the committee plans to solicit financial aid from industry.

• On the fuels front

Materials previously considered refinery byproducts are today being used in standard diesel fuels, according to Caterpillar Tractor Co. The "cracked distillates" or "recycle stocks" have been used successfully without harm to the engine when certain requirements are met. Chief problems mastered concerned formation of gummy conditions in storage, flow and spray characteristics necessary for high-pressure diesel fuel injection system, cetane numbers high enough to permit proper combustion, and careful attention to lubricating oil and oil changes. . . . The executive vice president of the National Coal Association, Tom Pickett, charges that "the Federal Government has become dangerously lopsided in its favoritism to coal's competitors, the oil and gas

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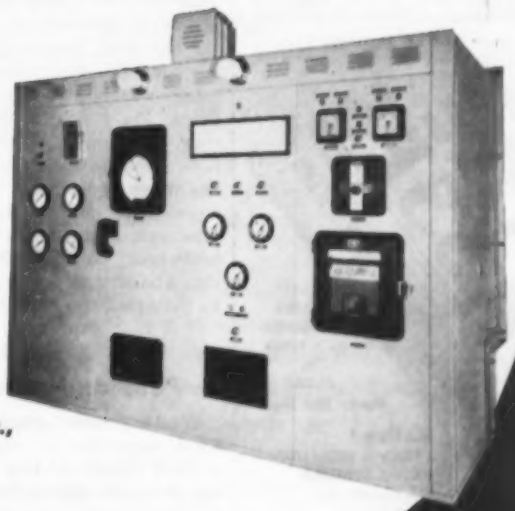

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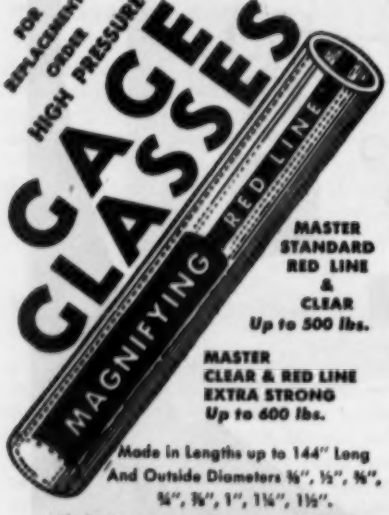

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FIG. 21—Lip Mold

FIG. 22—Standard

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spot news

. . . starts on page 86

industries." He cited Government policies in four areas as sufficient "to show that the Government's misdirected use of its power has unbalanced the fuels industry." The Government policies cited have to do with foreign oil imports, natural gas, freight rates, and atomic energy.

• Suppose automation disappeared!

Without automation and other forms of mechanization to increase worker productivity, the American standard of living would drop at least ten percent before 1960. This challenging thought was offered by R. C. Sollenberger, executive vice president of the Conveyor Equipment Manufacturers Association. His reason is that the population is increasing at a much more rapid rate than is the labor force. There are more young children and retired persons making up the total population. Young people go to school longer and, thus, postpone their entry into the labor force. More young wives are raising more children and, therefore, do not seek jobs as their mothers did. And the more prosperous the country becomes, the earlier old people retire. "Because of these factors," says Sollenberger, "output per worker must rise about two percent per year just to maintain the standard of living."

• Pure and perfect iron

Westinghouse research scientists have succeeded in making pure and perfect slivers of iron having breaking strength approaching 1,000,000 psi. Production on an unprecedented scale has been achieved in making crystals two inches long and 0.001 inches thick. These slivers, or "whiskers," are each so perfect that no defect can be detected. Most of the desirable properties of metals as we know them today are actually determined not by the metal itself but by the impurities and imperfections they may contain. Very little is actually known about the metals themselves in their completely pure and perfect state simply because they are never found that way in nature. It is not expected that pure and perfect iron will become a brand new construction material overnight. But its production has been put on a scale large enough that realistic studies can be made so that ways to utilize its unusual properties can be investigated.

• Little big inch to oil

The Federal Power Commission has just approved the proposal of the Texas Eastern Transmission Corporation to remove a major portion of the little big inch pipeline system from natural gas service and to convert it to the transportation of petroleum products. Some 1,168 miles of the line, extending from Beaumont, Texas to an Ohio river terminal near Moundsville, West Virginia, will be affected. Substitute facilities to maintain the company's delivery capacity will be constructed at a cost of some $71,800,000. The entire project will cost $86,600,000.

• Industrial show hits the road

The first traveling industrial exposition will launch a thirty city, coast-to-coast tour of the country in March, 1956. The show concerns instrumentation and electronics. Richard Rimbach, operator of the traveling show and other successful, stay-put industrial shows says that in spite of successful attendance at conventional shows there are still too many engineers who find it inconvenient or impossible to travel to the site of an exhibit.

• Changes in company lineups

Multi-Amp Corporation, a long-time manufacturer of special transformers for testing devices, is launching a new line of air-cooled transformers ranging from five va to 500 kva. . . . PROTO Tools is consolidating 15 sales zones in the United States into seven regions. . . . Worthington Corporation has been appointed exclusive national distributor for welding controls manufactured by Mullenbach Division of Electric Machinery

Manufacturing Company. . . . Monsanto Chemical Company's Plastics Division is constructing a new multimillion dollar facility for producing the plastic interlayer for safety glass. . . . Cleveland Crane & Engineering Company is building a $300,000 engineering building at Wickliffe, Ohio. . . . Allis-Chalmers is realigning its operating divisions to meet increased demands of growing markets. Six major operating divisions are being established. Three divisions will be in the industries group (formerly known as the general machinery division), and three will be in the tractor group (formerly called the tractor division). The power equipment division will include such equipment as turbines, condensers, transformers, switchgear, and nuclear power. The industrial equipment department will include processing machinery. The third industries division will be the general products division. Allis-Chalmers also is extending its impulse steam turbine-generator line to 16,500 kw units, for both utility and industrial service. . . . Penn Instruments Division of Burgess-Manning has created a separate municipal division to accommodate increased sales in the water and sewage fields.

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next month in

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Cement plant out in California found that enough heat could be recovered from kiln flue gases that all the electrical energy needed could be generated in the plant. Bonus benefit: slowing down and cooling the kiln gases while trapping the waste heat results in greater efficiency in the dust collection apparatus. Comprehensive study of the electrical system showed needs for more interrupting capacity. Complete details of the new steam and electrical systems are coming in

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ideas in action

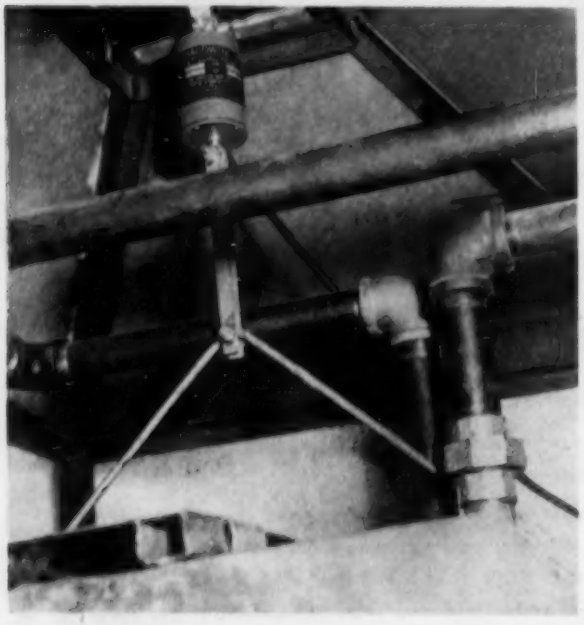
. . . starts on page 25

Horsepower savings in carrying coke oven gas through the modified absorption tower compensates for the horsepower required to operate the oil circulation system.

New way to measure lube oil

Lube oil consumption measurement during short duration tests is now possible. Losses of 0.1 to 0.2 pounds of oil in relatively large reservoir tanks are measured by Baldwin SR-4 load cells.

Oil consumption is one of the operating characteristics that are determined while jet engines are operating on test stands. Since oil consumption is small and the time of tests is relatively short, a sensitive device is needed to measure the small quantity accurately. Weight is a more



accurate measure than volume because volume is affected by aeration of the oil. Each weigh tank is suspended from a load cell inside a special enclosure which also houses oil pumps and filters. Oil is free to circulate to the engine bearings and then back to the reservoir tank.

Weight readings are taken while the engine is running and the oil is warm. A second reading is taken after a specified length of time. If any oil has been consumed, the second weight will be less than the first, and the difference indicates the net weight lost during the test period.

Safety policy sets world record

IBM's comprehensive industrial safety policy has set a world's record for the entire machinery industry: 14½ million man hours without a lost-time injury. Protective safety equipment, tailored to the personal needs of each worker, has been a major factor in last year's achievement

of this new safety record at the Endicott (N.Y.) plant of IBM. Management assigned top priority to the health and safety of plant personnel, even above plant output. A continuous effort is made to acquire the most effective equipment available. Any newly discovered industrial hazard is met immediately by a basic safety formula, and by acquisition of the most suitable safety equipment. Periodic examination of safety equipment in the light of new developments often results in replacement with improved models or entirely new devices. Accident prevention officers draw heavily on the specialized knowledge and experience of safety equipment suppliers, such as The Mine Safety Appliances Company. Safety equipment suppliers are familiar with every operation in the plant. This basic familiarity promotes prompt and thorough analyses of any new safety equipment inquiries. Cherished goal of the more than 9,800 plant personnel is an entire year of operations without loss of man hours from plant injury.

Skyscraper uses huge variety of valves

Some 2,500 R-P&C valves were installed in the new 23-story office building in Denver's Mile High Center, ranging from ⅛-inch check valves to 16-inch OS&Y gate valves.

Many of the larger gate valves are used in the building's mechanical plant which, in addition to serving the needs of the skyscraper, also supplies other buildings in the $15,000,000 center with steam and chilled water for air conditioning. The perimetrical heating and air conditioning system required over a thousand 125 and 250-pound R-P&C gate valves for heating units beneath the windows.

Atop the building, 12-inch gate valves are used on the cooling tower. Six-inch gate valves are used for domestic water storage. More than 25 floors below, 250-pound rising stem gate valves control snow melting coils for walks and other open areas at first-floor level.

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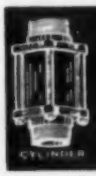
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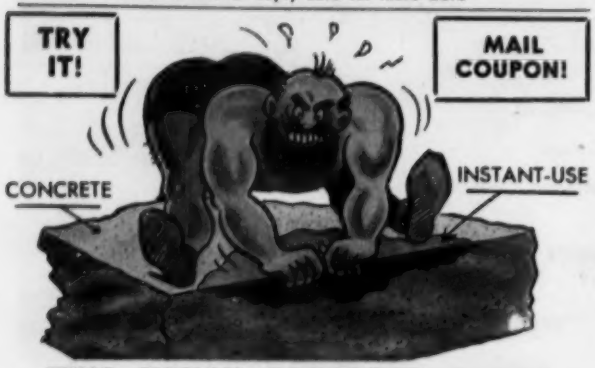

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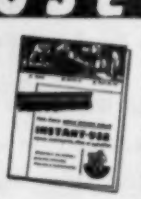

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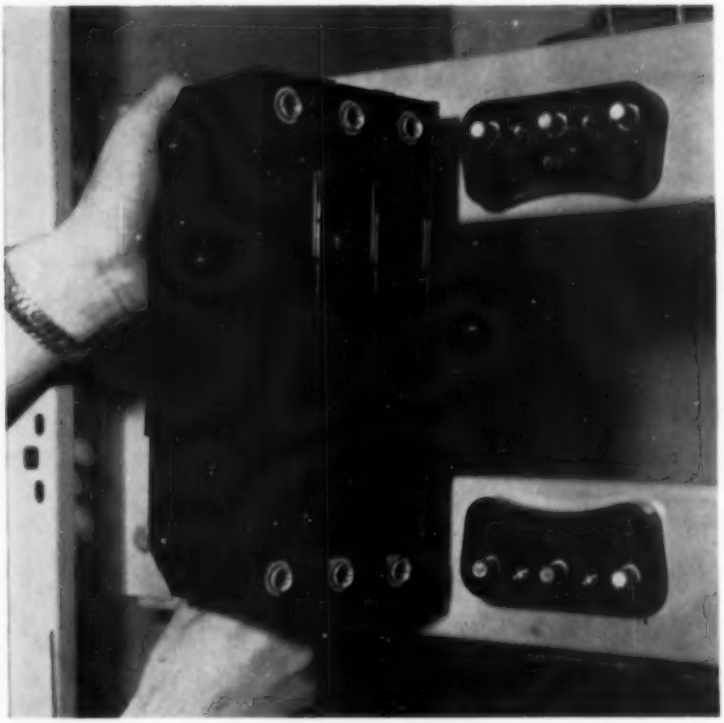
Specify I-T-E Plug-In Mounting for Molded Case Circuit Breaker Switchboards



IT'S EASY TO MOUNT an I-T-E Molded Case Circuit Breaker when it is equipped with plug-in arrangement. Simply place the integral connectors over the stationary jacks and seat the breaker. It's safe too. All terminals are shielded to provide maximum protection to the worker.

Why settle for less! I-T-E Molded Case Circuit Breakers designed for plug-in mounting in switchboard applications provide features and advantages you get only in this modern, streamlined construction. Plug-in mounting is a time-proved method employed for many years in maritime switchgear, and is approved by Underwriters Laboratories Inc.

Here are some of the advantages of I-T-E Plug-In Mounting: *Added Safety.* Breaker terminals are concealed. No live parts exposed. *Flexibility.* Breaker ratings can easily be changed within their respective frame sizes. *Ease of Installation.* Breakers simply *plug in.* Molded supporting block assures automatic alignment.

Investigate I-T-E Plug-In Mounting before specifying your next molded case breaker switchboard. I-T-E plug-in molded case circuit breakers are available in ratings from 15 to 600 amp, up to 600 v a-c, up to 250 v d-c.

For details, contact your I-T-E representative or leading independent switchboard manufacturers. Or write Small Air Circuit Breaker Division, I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Philadelphia 30, Pa.

FLEXIBILITY. Withdraw one breaker, insert another of the same frame size with the desired continuous ampere rating. No wiring changes, no tools needed. All I-T-E Molded Case Circuit Breakers can be supplied with plug-in mounting arrangement.

COMBINE TWO TYPES OF BREAKER in the same switchboard. Large air circuit breaker pantograph mounted for horizontal drawout. Molded case circuit breakers plug in mounted for easy installation and replacement.

I-T-E CIRCUIT BREAKER COMPANY • **Small Air Circuit Breaker Division**

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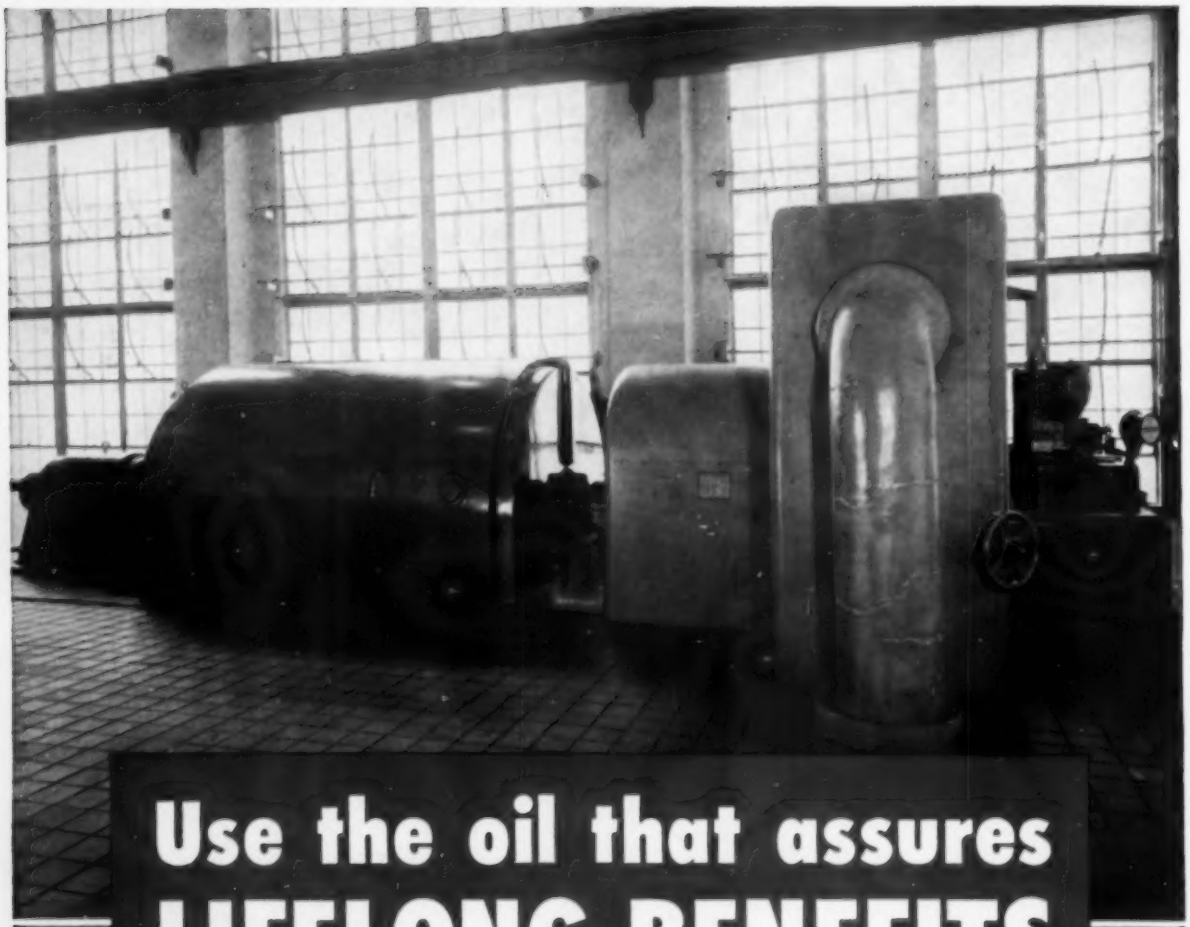

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Texaco Regal Oil R&O has been proved by tests to have *more than ten times the oxidation resistance* of ordinary turbine-quality oils—far greater ability to prevent sludge, rust and foam.

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